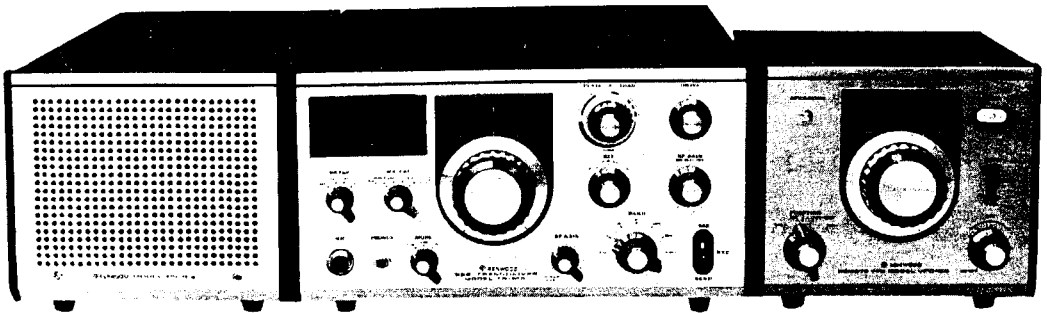


KENWOOD

SERVICE MANUAL



VARIABLE FREQUENCY OSCILLATOR

VFO-5S

SSB TRANSCEIVER

TS-515

POWER SUPPLY

PS-515

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SPECIFICATIONS

■ SPECIFICATIONS OF TS-515

FREQUENCY RANGE:	80 meter band	3.5 ~ 4.0 MHz
	40 meter band	7.0 ~ 7.3 MHz
	20 meter band	14.0 ~ 14.35 MHz
	15 meter band	21.0 ~ 21.45 MHz
	10 meter band	A 28.0 ~ 28.5 MHz
		B 28.5 ~ 29.1 MHz
		C 29.1 ~ 29.7 MHz
MODE:	SSB (A3j)	
	CW (A1)	
INPUT POWER TO FINAL STAGE:	3.5 ~ 21 MHz	180 W
	28 MHz	120W
	(When used with the PS-515 power supply)	
ANTENNA IMPEDANCE:	50 ~ 75 Ω	
CARRIER SUPPRESSION:	Better than 40 dB	
SIDEBAND SUPPRESSION:	Better than 40 dB	
MICROPHONE IMPEDANCE:	High impedance type (50 k Ω)	
TRANSMIT AUDIO FREQUENCY BANDWIDTH:	400 ~ 2600 Hz (-6 dB)	
HARMONIC RADIATION:	Better than 40 dB	
SENSITIVITY:	3.5 ~ 21 MHz band:	0.5 μ V S/N 10 dB
	28 MHz band:	1.5 μ V S/N 10 dB
IMAGE RATIO:	More than 50 dB	
IF INTERFERENCE:	More than 50 dB	
FREQUENCY STABILITY:	Within ± 2 kHz from one minute after switching on the set to 60 minutes and later with 100 Hz per 30 minutes.	
SELECTIVITY:	SSB and CW: More than ± 1.2 kHz at -6 dB and less than ± 2.4 kHz at -60 dB.	
AF OUTPUT:	More than 1 W (10% distortion)	
RECEIVER OUTPUT IMPEDANCE:	8 Ω for both speaker and headphone	
POWER CONSUMPTION:	At maximum transmission 350 W	
	At maximum reception 120 W	
	(When used with the PS-515 power supply)	
VACUUM TUBES AND TRANSISTORS:	Vacuum tubes	10
	FET	4
	Transistors	33
	Diodes	51
DIMENSIONS:	13" wide, 7-9/32" high, 13-5/8" deep	
WEIGHT:	22 lbs.	

■ SPECIFICATIONS OF VFO-5S

FREQUENCY RANGE:	80 meter band	3.5 ~ 4.0 MHz
	40 meter band	7.0 ~ 7.3 MHz
	20 meter band	14.0 ~ 14.35 MHz
	15 meter band	21.0 ~ 21.45 MHz
	10 meter A band	28.0 ~ 28.5 MHz
	10 meter B band	28.5 ~ 29.1 MHz
	10 meter C band	29.1 ~ 29.7 MHz
OSCILLATION FREQUENCY:	4.9 ~ 5.5 MHz	
OSCILLATION SYSTEM:	VFO section : Clapp OSC circuit	
	XTAL OSC : Pierce C-B circuit	
OUTPUT VOLTAGE:	1.0 V \pm 3 dB (with 470 Ω load)	
MAIN DIAL ACCURACY:	\pm 2 kHz	
FREQUENCY STABILITY:	Within 100 Hz for 30 minute period three minutes after switching-on (at normal temperature).	
SOLID STATE COMPONENTS:	6 transistors, 8 diodes	
POWER REQUIREMENT:	12.6 V AC, 250 mA, 150 V DC, 30 mA	
SIZE:	7-7/8" wide x 7-9/32" high x 7-9/16" deep	
WEIGHT:	7.5 lbs.	

■ SPECIFICATIONS OF PS-515

OUTPUT

Terminal	Voltage	Current	
900 V	840 V (940 V)	230mA (8mA)	DC
300 V	290 V (300 V)	20mA (8mA)	DC
190 V	200 V (220 V)	15mA (2mA)	DC
150 V	150 V (150 V)	45mA (85mA)	DC
-C	-88 V (-88 V)	13mA (15mA)	DC
12.6 V (a)	13.7 V	2.5 A	AC
12.6 V (b)	14.2 V	1.5 A	AC

Notes: The values are measured at the connector of the TS-515 when the TS-515 is in transmit mode with 90 watts output, in CW mode.
However, the values in () are measured when the TS-515 is in receive mode in CW mode.

SPEAKER SECTION

Diameter	3-17/32" x 5-1/2" (Ellipsoidal)
Impedance	8 ohms
Frequency response	150 ~ 5,000 Hz
Rated input	1.5 watts (max.)

POWER REQUIREMENT

AC 110 ~ 120/220 ~ 240 V, 50/60 Hz
350 watts (max.)

DIMENSIONS

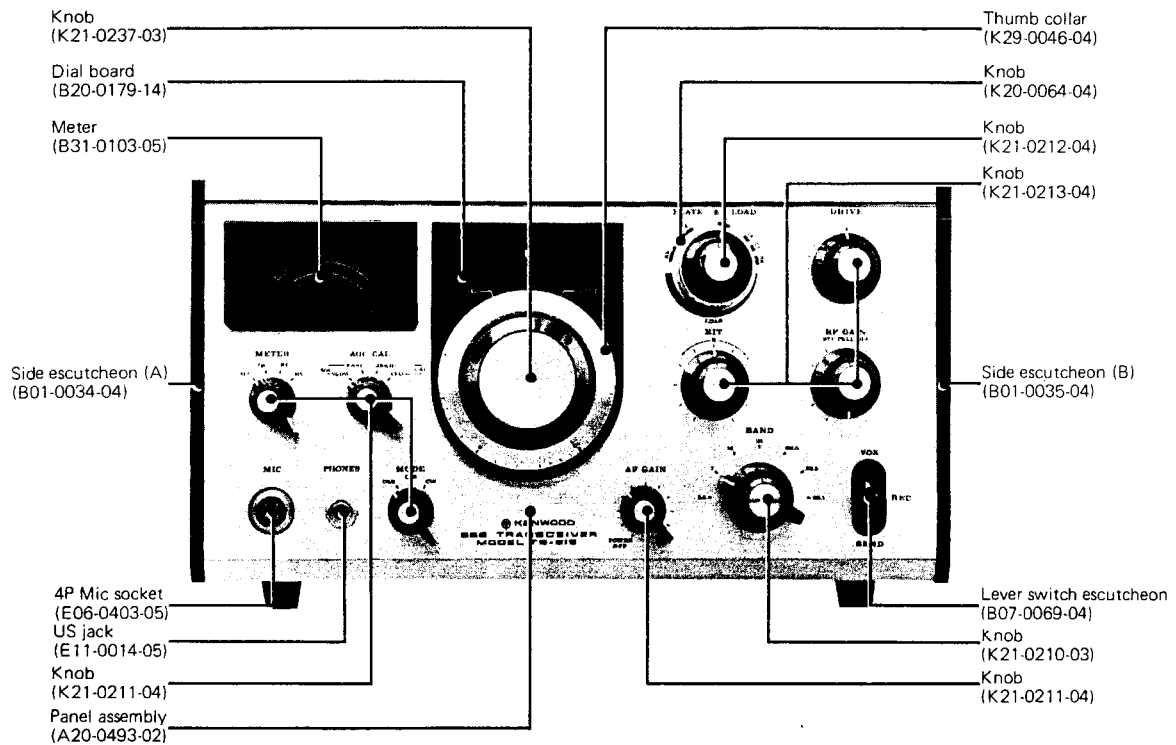
7-7/8" wide x 6-11/16" high x 13-6/8" deep (Excluding feet)

WEIGHT

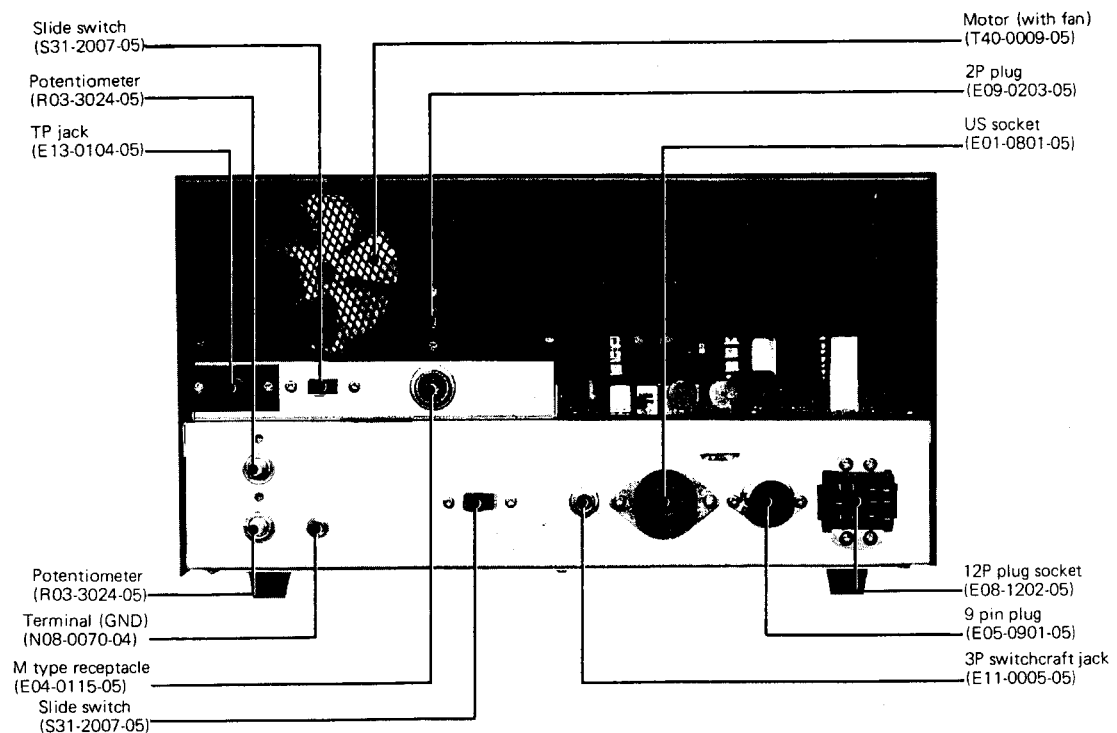
26.4 lbs.

EXTERNAL VIEW & CHASSIS VIEW

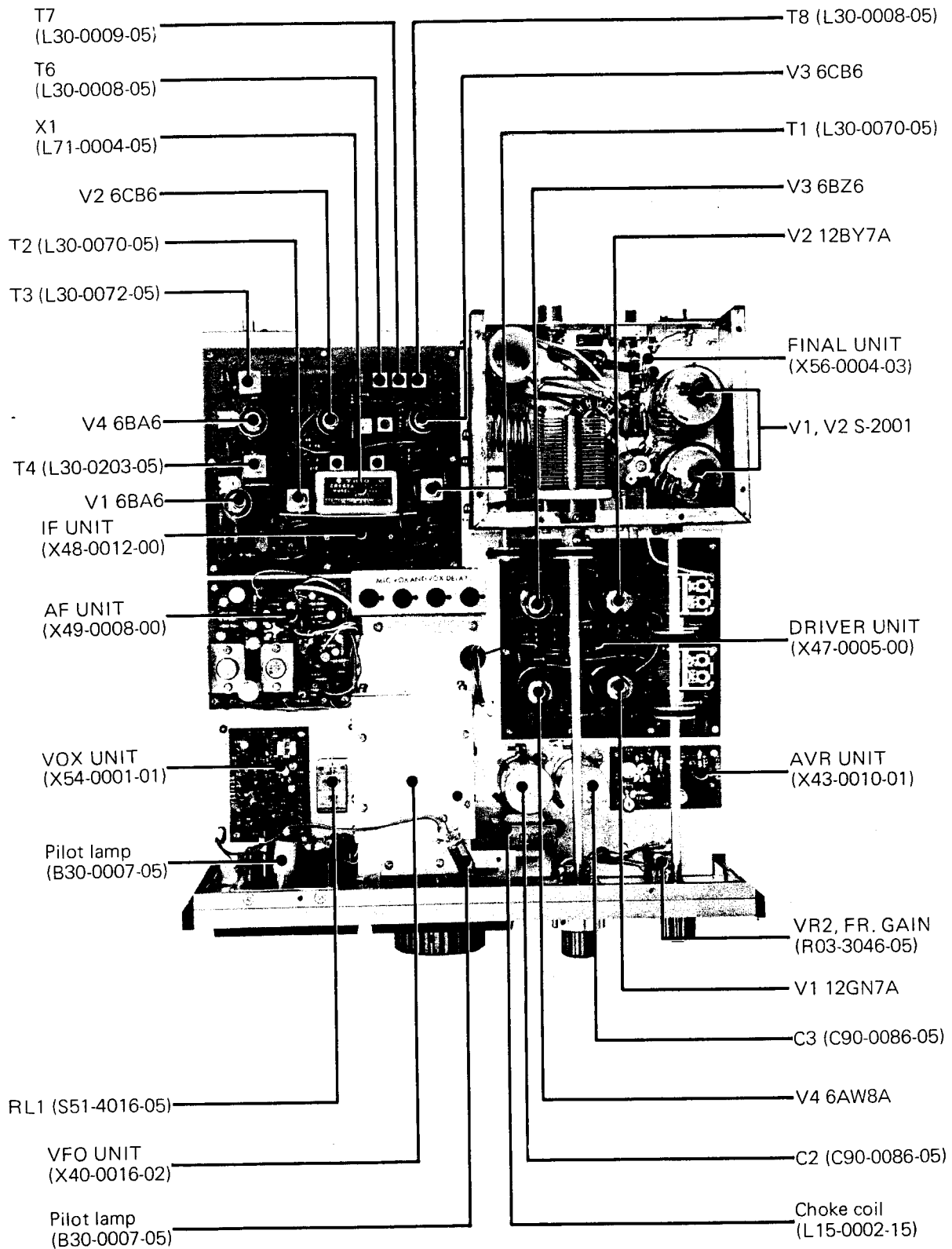
■ TS-515 EXTERNAL VIEW (FRONT)



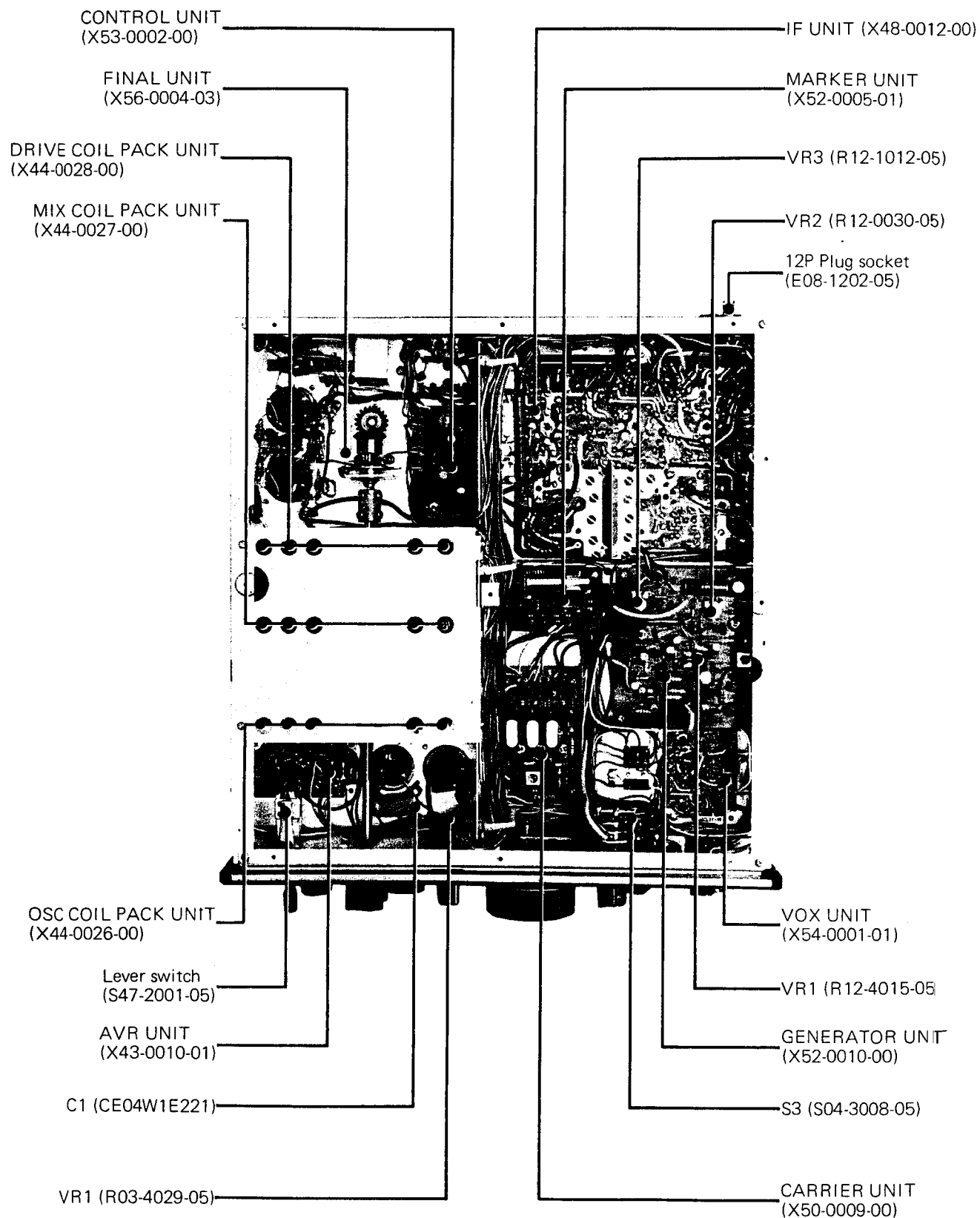
■ TS-515 EXTERNAL VIEW (REAR)



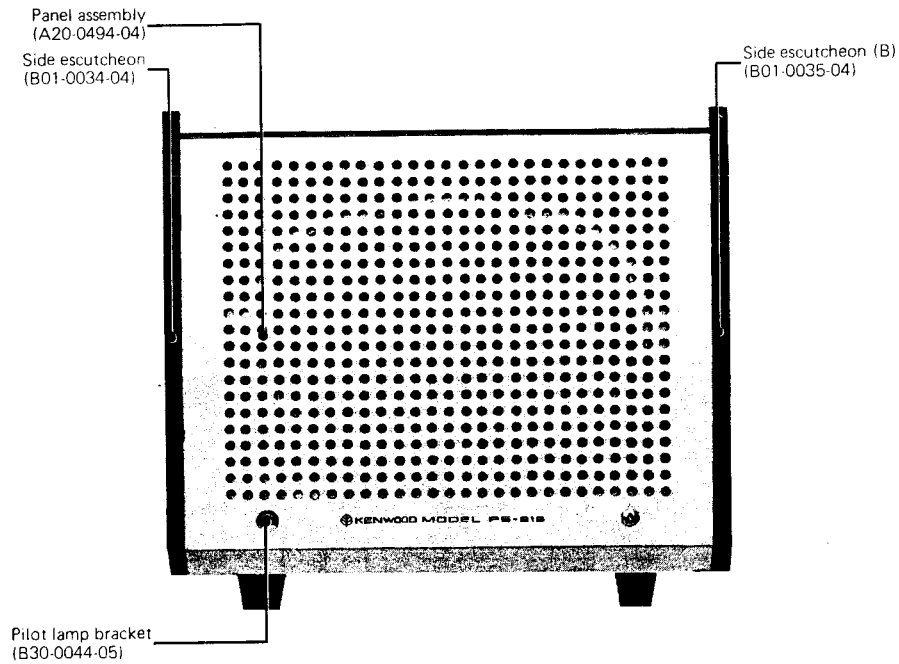
■ TS-515 CHASSIS VIEW (TOP)



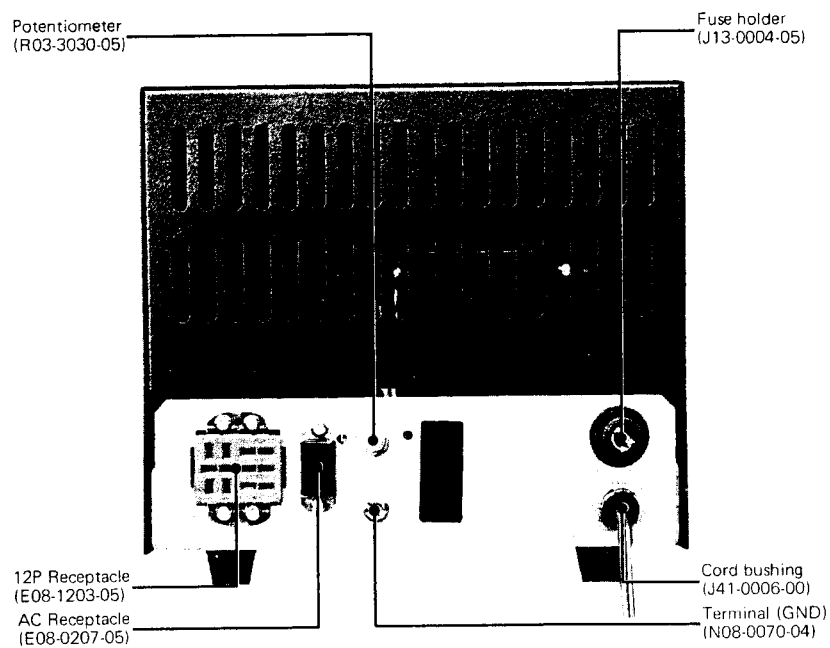
■ TS-515 CHASSIS VIEW (BOTTOM)



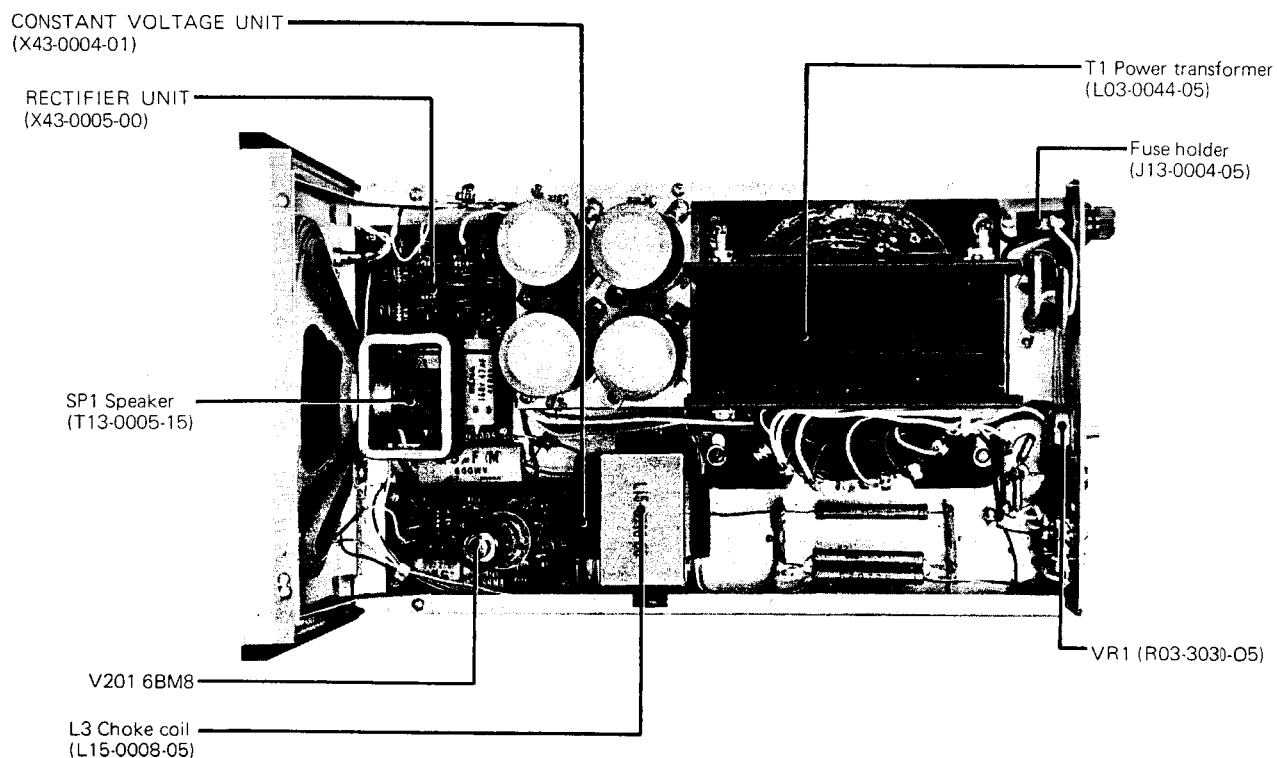
■ PS-515 EXTERNAL VIEW (FRONT)



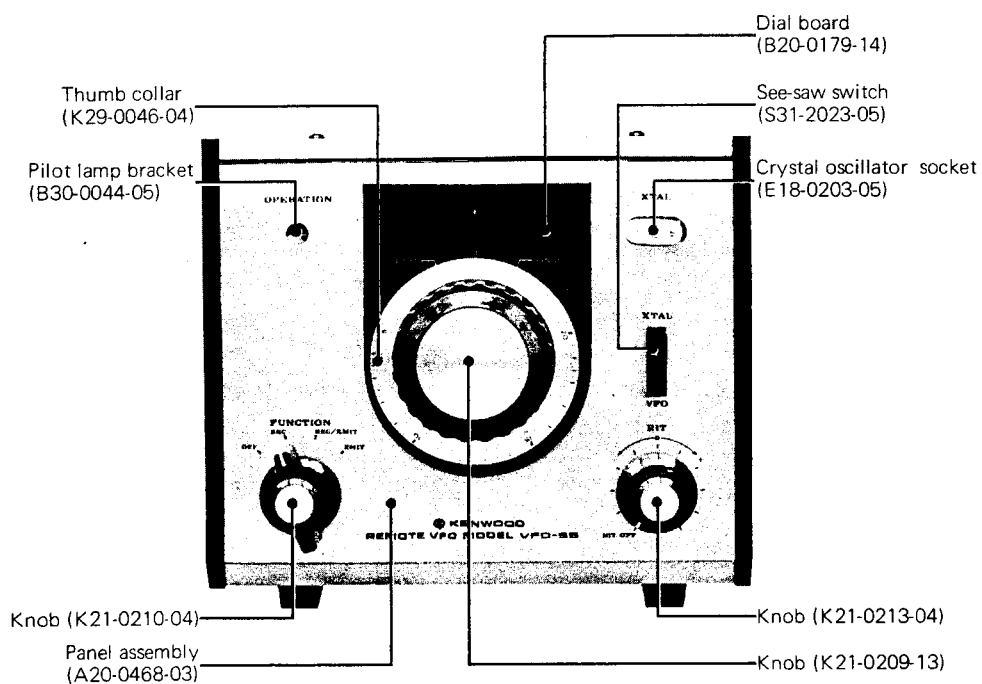
■ PS-515 EXTERNAL VIEW (REAR)



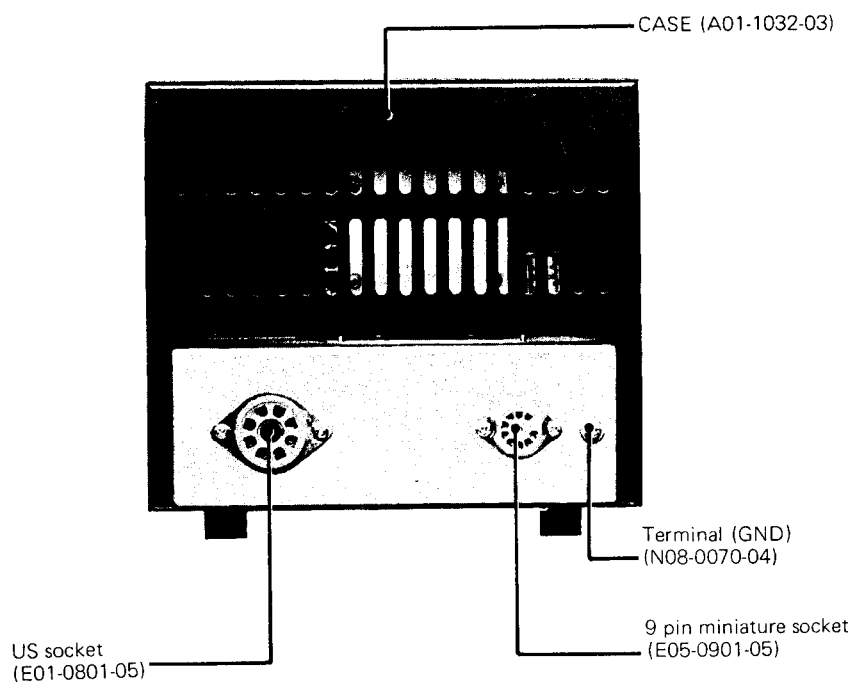
■ PS-515 CHASSIS VIEW (TOP)



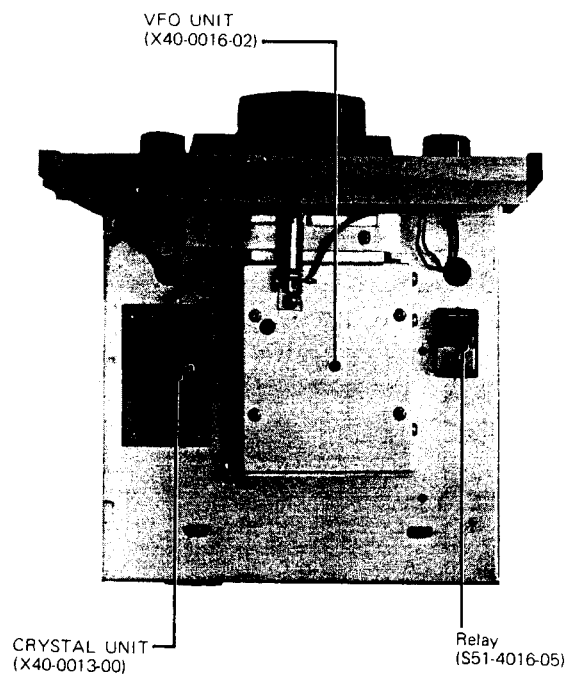
■ VFO-5S EXTERNAL VIEW (FRONT)



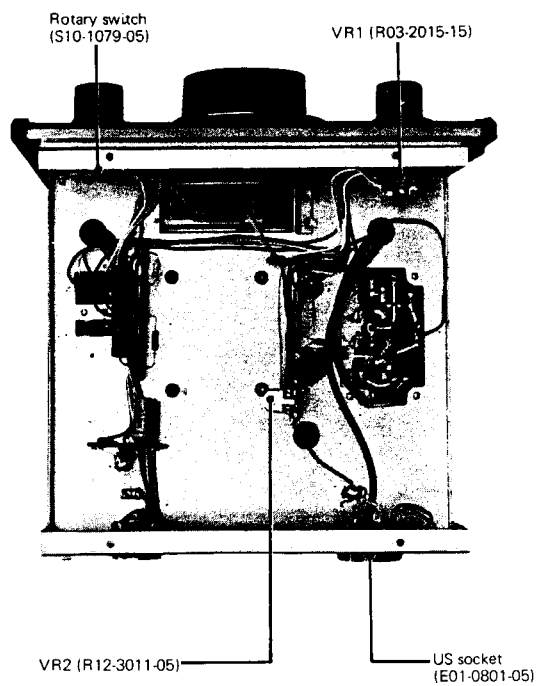
■ VFO-5S EXTERNAL VIEW (REAR)



■ VFO-5S CHASSIS VIEW (TOP)

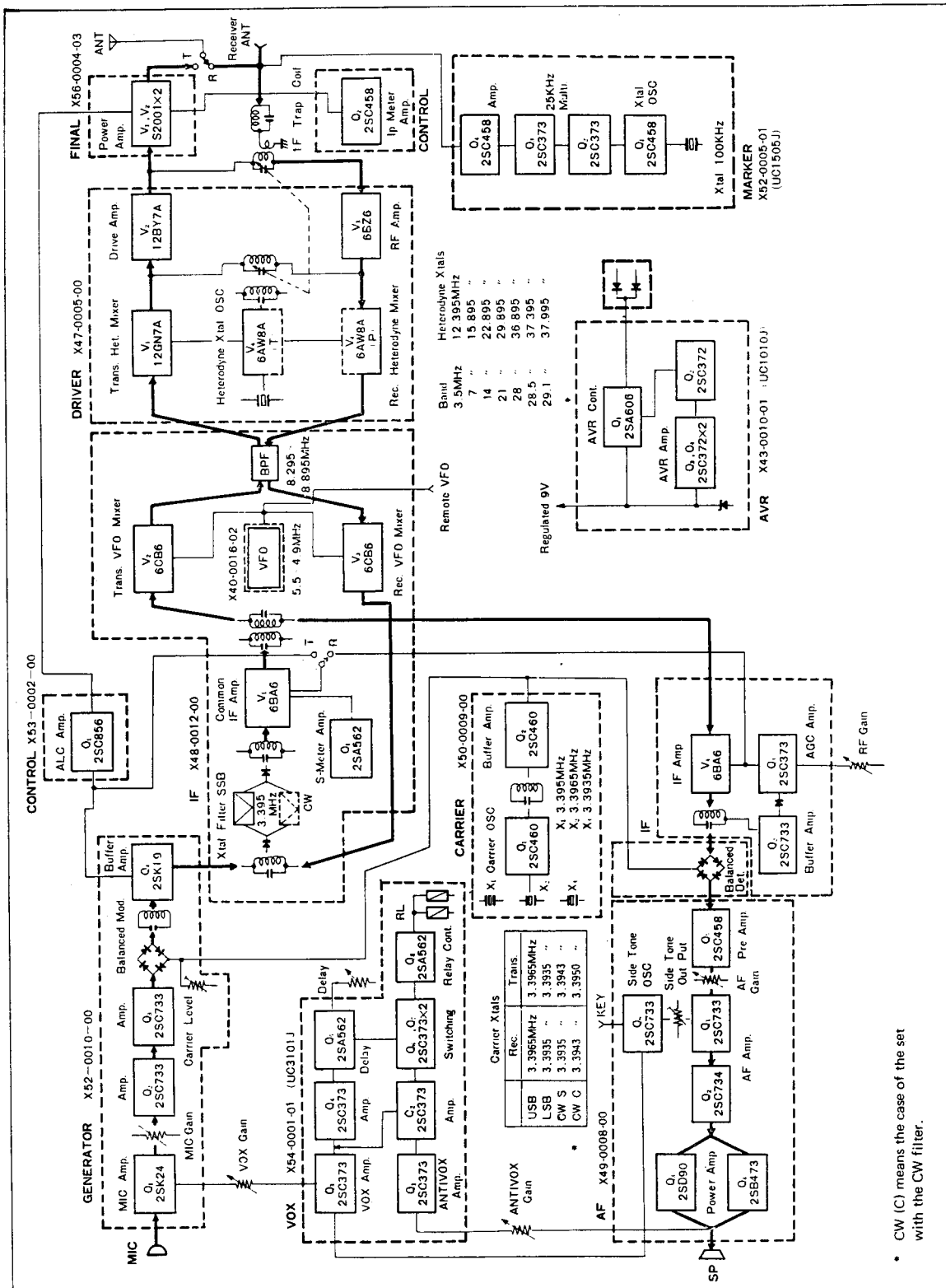


■ VFO-5S CHASSIS VIEW (BOTTOM)

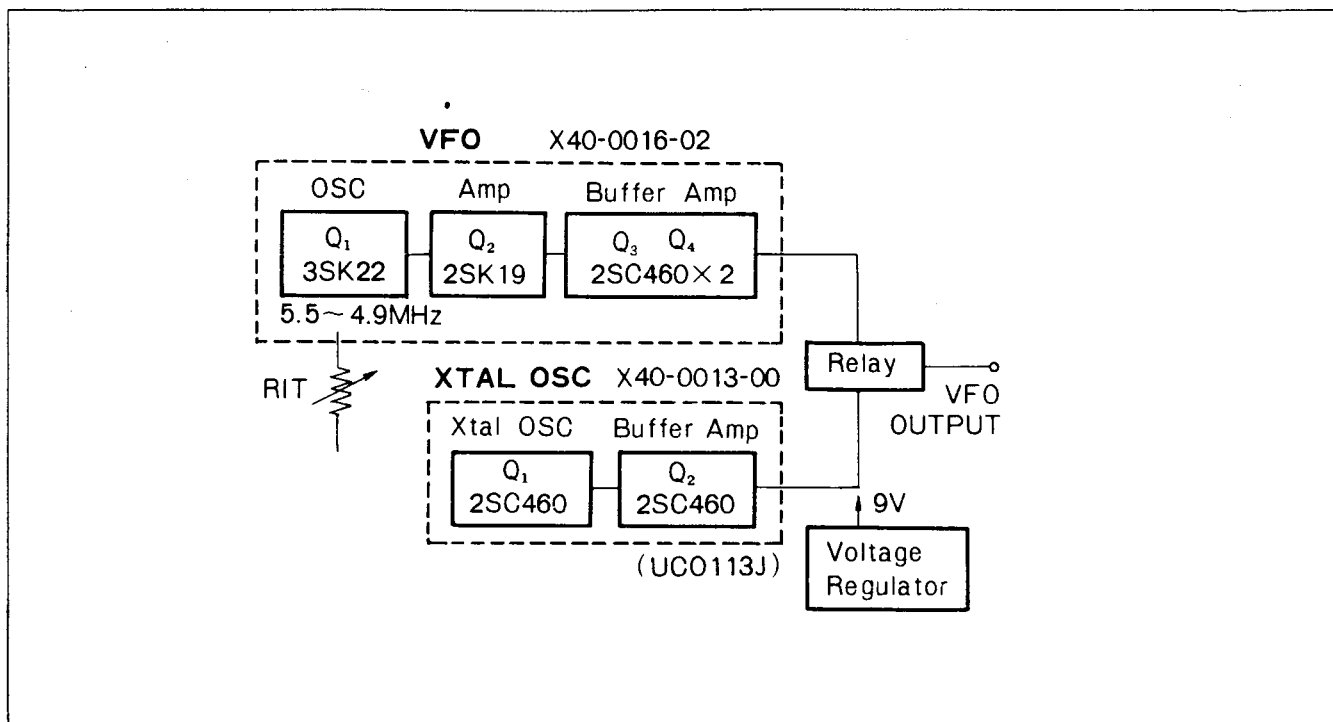


BLOCK DIAGRAM

■ BLOCK DIAGRAM OF TS-515



■ BLOCK DIAGRAM OF VFO-5S



TROUBLE SHOOTING

■ RECEIVER PORTION

Symptom	Probable Cause	Correction
1. No sound	A. Speaker in the power supply portion is out of order.	a. Check conductivity. • Ascertainment by a head phone.
2. Neither a set noise nor a residual ham is audible.	A. Disconnection of a wire from the SP terminal in the AF unit to the speaker, or contact failure in the connector. B. AF circuit is abnormal. 1) Degradation of power transistor. 2) Trouble at around AF GAIN variable resistor VR1 (50k Ω) 3) Trouble in each transistor.	a. Check conductivity. a. Check voltage at each pin and ascertain the base current. a. Check conductivity. a. Check voltage. Ascertainment by a low frequency oscillator.
3. Residual ham sounds, but no set noise. (or very weak)	A. Oscillation in each oscillator stops. 1) Carrier oscillator. • Mismatching of output coil T1. • Diode switch is defective. • Constant voltage regulator is out of order. 2) VFO-5S • Resistor R7 5.6k Ω (7W) is broken, or diode DI RD9AM is short-circuit. • Disconnection of output coaxial cable. • Trouble in each transistor. 3) Heterodyne crystal oscillation • Mismatching of each oscillation coil. • Contact failure of rotary switch. • 6AW8A tube is defective. (in triode portion). B. IF. RF. ANT 1) IF circuit • Trouble in vacuum tube V1, 4 6BA6, V3 6CB6. Disconnection of heater. • Mismatching or disconnection of IFT T1 ~ 4. • Disconnection of trap coil T11 or of LPF coils T9 and T10. • Mismatching or disconnection of BPF. • Trouble in diode switch circuit.	a. Readjustment by RF vacuum-tube voltmeter. a. Check voltage and conductivity of MODE switch. a. Check voltage. a. Check voltage at the B terminal. a. Check conductivity. a. Check voltage at each pin. a. Readjust it in accordance with instructions concerning adjustment. a. Check conductivity. a. Check voltage at each electrode. Ascertainment by replacement. (Checking in accordance with the level diagram must be carried out.) a. Check voltage at each electrode. Ascertainment by replacement. a. Readjustment by SSG. Check conductivity. a. Check conductivity. a. Adjustment by sweep. (Refer to maintenance instructions on Page 23.) Check conductivity. a. Check voltage and current of the diode.

Symptom	Probable Cause	Correction
	2) RF, ANT circuit <ul style="list-style-type: none"> • Mismatching of ANT and RF coils. • Contact failure of rotary switch. • Disconnection of coaxial cable in ANT circuit and 8.6MHz trap. • Contact failure of relay RL1 ~ 1, RL1 ~ 2 and antenna switch S2 in the final unit. • Short-circuit of tuning variable capacitor VC1, VC2. • Trouble in vacuum-tubes V3, 6BZ6, V4, 6AW8. Disconnection of heater. 	a. Adjustment by SSG or built-in marker. a. Check conductivity. a. Check conductivity. a. Check conductivity. a. Check conductivity of variable capacitor after disjoining lead wires to "MVC" and "DVC" terminals in the drive unit coil pack. a. Check conductivity.
4. S meter does not swing, or swing slightly.	A. Trouble in S meter circuit. <ol style="list-style-type: none"> 1) Incomplete adjustment of zero-set semi-fixed variable resistor VR1 (5kΩ). 2) Incomplete adjustment of sensitivity-set semi-fixed variable resistor VR2 (500kΩ). 3) Contact failure of AGC/CAL switch S2 ~ 5 and relay RL1 ~ 4 in the final unit. B. Trouble in AGC circuit. <ol style="list-style-type: none"> 1) Abnormal operation of transistors Q2, 2SC733, Q3, 2SC373 in the IF unit. 2) Disconnection of coil REC L9 (1mH) in the IF unit. 	a. Adjust it in accordance with instructions concerning adjustment. a. Adjustment by SSG (Refer to maintenance instructions.) a. Check conductivity. a. Check voltage at each pin. a. Check conductivity.
5. Marker does not operate.	A. Marker unit. <ol style="list-style-type: none"> 1) Contact failure of AGC/CAL switch S2 ~ 6. 2) Disconnection of coaxial cable leading to the MO terminal. 3) Disconnection of coil L1 (12mH) of RFC. 4) Crystal oscillator X1 (100kHz) is out of order. 	a. Check conductivity and voltage at the terminal "9" a. Check conductivity. a. Check conductivity and collector voltage of Q1 2SC373. a. Replace.

■ TRANSMITTER PORTION

Symptom	Probable Cause	Correction
1. No output.	A. Final unit <ol style="list-style-type: none"> 1) Degradation of S-2001 or operation failure. 	a. Check voltage at each electrode or ascertainment by replacement.

Symptom	Probable Cause	Correction
	2) Contact failure of relay RL1 ~ 1. 3) Contact failure of rotary switch S1. 4) Short-circuit of VC2 (loading variable capacitor). B. Oscillation in each oscillator stops. Carrier, VFO; Heterodyne crystal. C. Degradation of vacuum-tube or disconnection of heater. IF unit V1 6BA6, V2 6CB6, drive unit V1 12GN7A V2 12BY7A. D. Generator unit. 1) Reed relay (RL1) is defective. 2) Contact failure of MODE switch S3~1. 3) Trouble in FET Q4 2SK19 GR. 4) Contact failure or disconnection at around MIC GAIN VR6 (10k Ω).	a. Check conductivity. a. Check conductivity. a. Check conductivity. a. Refer to descriptions concerning the symptom of receiver. (Page 14) a. Check voltage at each electrode. a. Check conductivity of contacts and coil. a. Check conductivity and voltage at "BM" terminal. a. Check voltage at each pin. a. Check conductivity.
2. Low output	A. Degradation of S-2001, or operation failure. B. Degradation of vacuum-tubes. C. Mismatching of IFT & tuning coil.	a. Check voltage at each electrode. Ascertainment by replacement. a. Check voltage at each electrode. Ascertainment by replacement. a. Refer to paragraphs concerning the countermeasure to trouble of the receiver and the level diagram of the transmitter.
3. No deflection in Ip.	A. Operation failure of S-2001. B. Contact failure of SG switch. C. Trouble in the meter circuit (Disconnection of lead wire).	a. Check voltage at each electrode. a. Check conductivity or voltage. a. Check conductivity.
4. No deflection in ALC (28MHz band is out of question).	A. Control unit. 1) Q1 2SC856 is defective. B. ALC circuit 1) Short-circuit in the ALC circuit. 2) Contact failure of relay RL1 ~ 3. C. Drive voltage is insufficient.	a. Check voltage. a. Check conductivity. a. Check conductivity. a. Refer to symptoms 1 and 2.
5. No deflection in HV.	A. Power supply operation failure. B. Disconnection resistor R5 ~ 7 in the final unit.	a. Refer to the power supply. (Page 17) a. Check conductivity and voltage at the joint of reach resistor.
6. STAND-BY switch is defective (including PTT).	A. Contact failure of STAND-BY switch. (lever switch) B. Disconnection of lead wires at around the "VS" or "SS" terminal in the VOX unit. C. Trouble in Q8 2SA562 in the VOX unit. Short-circuit of the diode D8 1N60.	a. Check conductivity and voltage. a. Check conductivity and voltage. a. Check voltage.

■ OTHERS

Symptom	Probable Cause	Correction
1. Stabilized voltage at 9V cannot be obtained.	A. Degradation of transistors and zener diodes.	a. Check voltage at each pin.
2. Fan is out of order.	A. Motor is out of order. B. Disconnection of cables and contact failure of the connector.	a. Check conductivity of the fan connector in the final unit. a. Check conductivity.

■ PS-515

Symptom	Probable Cause	Correction
1. High voltage of 900 volts is not obtained.	A. High voltage diodes, D101~104, S-1.5-08 are damaged. B. Electrolytic capacitors C7 and C8 are defective (leak or short-circuit).	a. Check conductivity. a. Check conductivity and terminal voltage at the capacitor.
2. Stabilized voltage of 150V is not stable, or setting at 150V is not possible.	A. Degradation of V201 6BM8 and N201 NE-2.	a. Check voltage at each electrode. Ascertainment by replacement.
3. Neon bulb on the front panel does not light.	A. Disconnection of lead wires with in a neon tube.	a. Replacement.

■ MEASURING INSTRUMENTS

1) Voltmeter

- Input resistance More than $1\text{M}\Omega$
- Range (AC, DC) 1.5V to 1000V F.S.

[Note] When no suitable measuring instrument is available, any type of circuit tester with high accuracy may be used. Bear in mind that the accurate indication may not be obtained especially when high impedance circuit is measured by use of such circuit tester.

2) RF vacuum tube voltmeter

- Input impedance More than $1\text{M}\Omega$
Less than 20PF
- Range 10mV to 300V F.S.
- Frequency More than 50MHz

[Note] In case the adjustment with particular accuracy is not required (adjustment of carrier oscillation and heterodyne crystal and the like), a voltmeter or circuit tester may be used with the output of wave detector as will be described later.

3) Sweep generator

- Center frequency 8.6MHz
- Frequency deviation More than $\pm 500\text{kHz}$ (max.)
- Output voltage More than 0.1V
- Sweep speed 50Hz or 60Hz
- Marker 8.3MHz, 8.6MHz, and 8.9MHz desirable

4) Detector

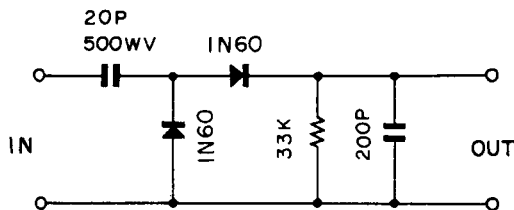


Fig. 1 Filter detector

[Note] 1. Surely use a specified diode.
2. Output must be taken out with a shield wire.

5) Oscilloscope

High sensitivity, external synchronize obtainable.

6) Slow sweep generator

- Center frequency 3395kHz
- Frequency deviation Max. $\pm 5\text{kHz}$
- Output voltage More than 0.1V
- Sweep speed Min. 0.5 sec/cm

7) Afterglow oscilloscope

- Has afterglow characteristic. More than 1 sec.
- Both vertical and horizontal amplifiers are DC amplifiers.

8) SSG

- Frequency 3MHz to 30MHz
- Output 0dB/ μV to 120dB/ μV
- High stable SSG with less frequency modulated component required.

9) AF generator

- Frequency 300Hz to 5kHz
- Output voltage Max. 1V
- Distortion factor Less than 0.5% (at 1500Hz)

10) Frequency counter

- Minimum input voltage Less than 10kHz
- Frequency More than 10MHz

11) AF vacuum tube voltmeter

- Frequency 50Hz to 10kHz
- Input resistance More than $1\text{M}\Omega$
- Range 10mV to 30V F.S.

12) AF dummy load

- Impedance 8Ω
- Power More than 3W

13) RF dummy load

- Impedance 50Ω to 75Ω
- Power More than 200W
- Frequency 3.5MHz ~ 30MHz

■ PRELIMINARY OPERATIONS

1. How to remove a casing and the likes.

An upper cover, casing and bottom plate must be removed in accordance with Fig. 2 and 3.

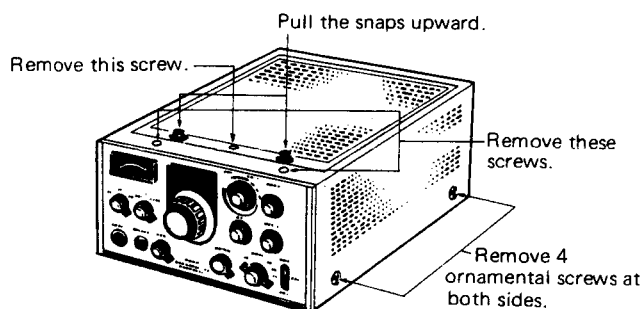


Fig. 2

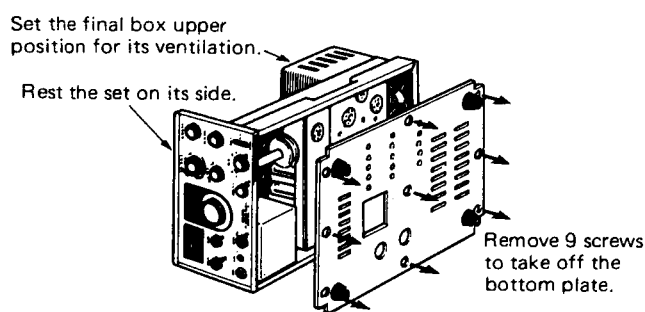


Fig. 3

2. Checking of parts

- (1) Crystal, vacuum tube
- (2) VFO remote terminal plug
- (3) Connect a dummy load of 8 ohms (more than 3W) to the PHONES terminal.

3. Setting of variable resistor (VR), switches and the likes.

- (1) Final bias VR (VR5) → Fully counterclockwise position
- (2) RF gain VR → Fully clockwise position
- (3) SG switch → Off position
- (4) Antenna switch and the likes → REC position
- (5) Make connections of the fan cable

4. Checking of voltages (under receiving condition)

Refer to Table 1-a, 1-b with respect to voltages in various portions.

(1) DC (+)

- 1) Power connector terminal No. 4; +150V
- 2) Power connector terminal No. 7; +215V ±10V
- 3) Power connector terminal No. 10; +300V ±10V
- 4) OUT terminal of X43-0010-00 or Collector (casing) of 2SA606; +9V

[Note] Adjust by VR1 on the unit when it diverges from +9V.

(2) DC (—)

- 1) Power connector terminal No. 1; -90V ±10V
- 2) RB relay (relay RL1 ~ 2 in main body), pin 14; 0V
- 3) TB relay (relay RL1 ~ 2 in main body), pin 16; about -35V
- 4) Final bias 6LQ6, 1st grid (pin 5); about -70V

[Note] Short-circuiting with others is by no means permitted when the voltmeter is connected to the first grid.

(3) AC (heater voltage)

- 1) Power connector terminal No. 5; 12.6V ±1V
- 2) Power connector terminal No. 8; 12.6V ±1V

5. Others

- (1) In principle, the STAND-BY switch should be placed at REC during preliminary stages and adjustment of receiver.
- (2) When I_p of more than 150mA is flowing, the final stage should always be kept completely tuned.
- (3) During operation, ventilation by a fan should be complete.

■ VOLTAGE MEASUREMENTS OF TUBES

(In Volts)

Unit	Pin No.		1	2	3	4	5	6	7	8	9
FINAL	V1 S2001	T R	0.28 0	(12.6)	200 220	0.28 0	-44 -60	0.28 0	(6.3)	0	
	V2 S2001	T R	0.28 0	(6.3)	200 220	0.28 0	-44 -60	0.28 0	0	0	
DRIVE	V1 12GN7A	T R	2.3 0	-33		(12.6)	(12.6)	(6.3)	285 290	70 133	
	V2 12BY7A	T R	5 0	-33		(12.6)	(12.6)	(6.3)	285 290	200 220	
	V3 6BZ6	T R	0 -0.3	66 0.7	(6.3)		290 295	140 64			
	V4 6AW8A	T R		-5.2 -5.2	150 150	129 129	(6.3)	0 (4.3)	-42 0	137 127	136 131
IF	V1 6BA6	T R	-5.2 -0.2		(6.3)	(12.6)	142 130	144 130	0.8 1.9		
	V2 6CB6	T R	0 -33	1.24 -16.5		(6.3)	135 136	43 133			
	V3 6CB6	T R	-42 0	-20 1.9		(6.3)	136 134	137 134			
	V4 6BA6	T R	0 -0.2		(6.3)	(12.6)	150 130	150 130	74 1.9		

- [Note] 1. Voltage values obtained with the VTVM having 11M Ω of input impedance.
2. T: Maximum transmitting condition (CW)
R: Reception with no input
3. The value in () denotes the AC voltage and others are DC voltage.

[Table 1-a]

■ VOLTAGE MEASUREMENTS OF TRANSISTORS

(In Volts)

Unit	Transistor		Emit- ter or Source	Collec- tor or Drain	Base or 1st Gate	2nd Gate
VFO (X40-0016 -05)	Q1 3SK22	R	0.2	8.8	0	0
	Q2 2SK19	R	0.6	8.8	0	
	Q3 2SC460	R	2.3	8.8	3	
	Q4 2SC460	R	1.0	8.8	2.3	
AVR (X43-0010 -00)	Q1 2SA606	T	11	9	9	
		R	12.4			
	Q2 2SC372	R	5.2	9	5.5	
	Q3 2SC372	R	5	5.8	5.5	
IF (X48-0012 -03)	Q1 2SA562	R	2.4	0	1.9	
		T	6.7	15.2	7.1	
	Q2 2SC733	R	7.4	16.2	7.6	
	Q3 2SC373	T	-25	0	-24.5	
		R	-25.5	-0.25	-25	
	Q1 2SC733	R	2.6	16	3.2	
	Q2 2SC734	R	0.4	8.5	1	
	Q3 2SD90	R	8.5	16.5	8.9	
AF (X49-0008 -00)	Q4 2SB473	R	8.5	0	8.5	
		T	0.9	8.7	0.9	
	Q5 2SC458	R	0.3	7	0.9	
	Q6 2SC733	T	0.9	13	1.35	
CARRIER (X50-0009 -00)	Q1 2SC460	R	0.9	9	1.4	
	Q2 2SC460	R	1.2	9	1.9	
GENERA- TOR (X52-0010 -00)	Q1 2SK24	T	0.6	2	0	
	Q2 2SC733	T	1.5	4.5	2	
	Q3 2SC733	T	0.4	2	1	
	Q4 2SK19	T	0.55	11.7	-0.8	

Unit	Transistor		Emitter or Source	Collec- tor or Drain	Base or 1st Gate	2nd Gate
CONTROL (X53-0002 -00)	Q1 2SC856	T	-50	-4.5	-44	
	Q2 2SC458	T	0.35	6.5	0.95	
VOX (X54-0001 -01)	Q1 2SC373	T	0	0.65	0.6	
		R	0	0.13	0.65	
	Q2 2SC373	T	0	0	0.23	
		R	0	0	0.67	
	Q3 2SC373	T	0.6	6.1	1.2	
		T	0	0.65	0.25	
	Q4 2SC373	R	0	8.5	0	
		T	0.65	0	0.65	
	Q5 2SA562	R	8.5	0	8.5	
		T	5.7	5.8	6.5	
	Q7 2SC373	T	5.7	13		
		R		16.5		
MARKER (X52-0005 -01)	Q8 2SA562	T	14.5	13.8	13.8	
		R	16.5	0	16.5	
	Q1 2SC458	T	0.05	9	0.7	
	Q2 2SC373	T	0	1.9	-0.1	
	Q3 2SC373	T	0	6.9	-2	
	Q4 2SC458	T	0	8.1	0	

[Note] T: Under maximum CW transmitting output
R: Under no signal receiving

[Table 1-b]

ADJUSTMENT

■ ADJUSTMENTS OF TS-515 RECEIVE SECTION

1. Heterodyne crystal oscillator (Refer to Fig. 4)

(1) Purpose:

To set heterodyne crystal in oscillation.

(2) Measuring instrument:

RF vacuum tube voltmeter

(3) Adjusting procedures:

- 1) Connect the RF vacuum tube voltmeter to the MP terminal located on the unit X47-0005-01 through a capacitor of $0.01\mu\text{F}$ ceramic, more than 500WV.

[Note] Be careful of the voltage of 300V DC at the MP terminals.

- 2) Adjustment of each coil of the coil pack X44-0026-00 should be made in accordance with following table.
- 3) Ascertain that the device is oscillating at a frequency of 28.5MHz and 29.1MHz.
- 4) Disconnect the capacitor of $0.01\mu\text{F}$.

Band SW	Coil	Adjustment
3.5 MHz	L1	Adjust the core to a point 10%
7 MHz	L2	lower than when maximum
14 MHz	L3	oscillation is obtained.
21 MHz	L4	In like manner adjust to
28 MHz	L5a	15% point.

Table 2

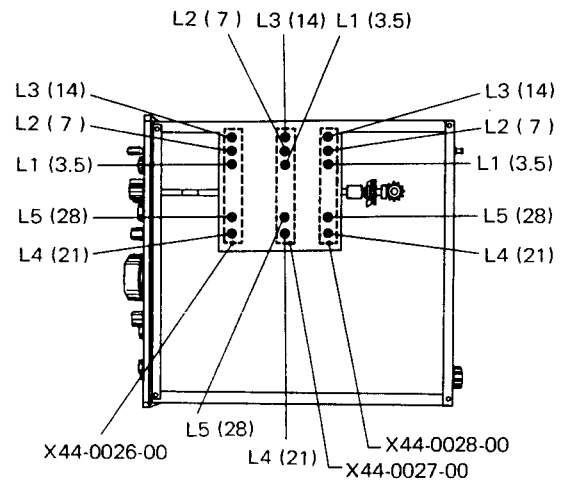


Fig. 4

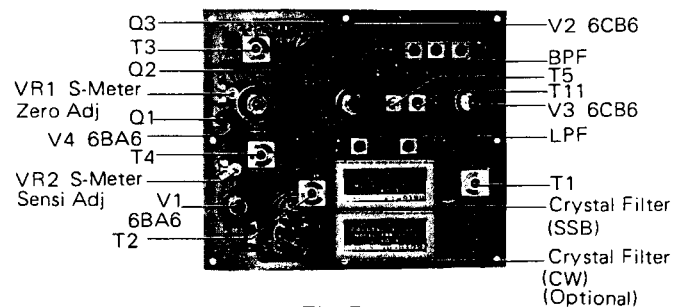


Fig. 5

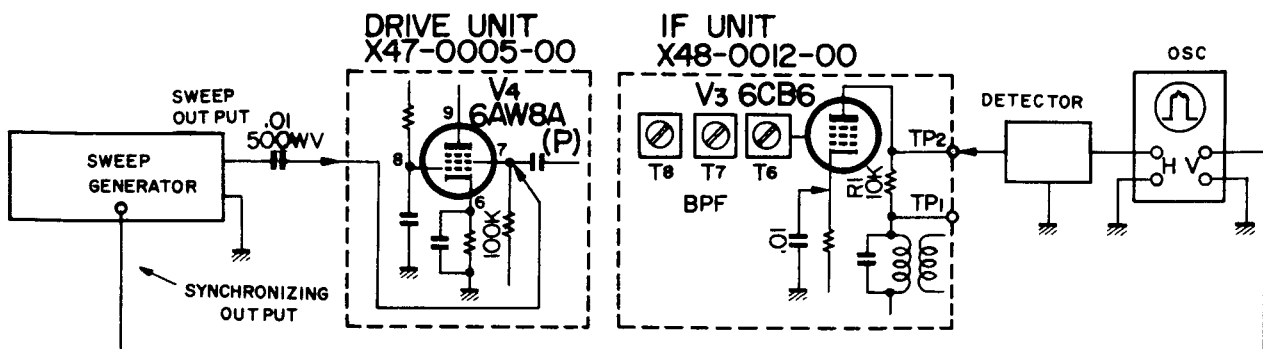


Fig. 6

2. BPF (bandpass filter)

(1) Purpose:

To obtain a required bandwidth by adjusting the bandpass filter.

(2) Measuring instruments:

- 1) Sweep generator
- 2) Filter detector
- 3) Oscilloscope

(3) Adjusting procedures: (Refer to Fig. 6)

- 1) Disconnect the wire to the TP1 and TP2 terminals on the printed circuit board of the IF unit X48-0012-00.
- 2) Connect the sweep generator to the first grid (pin 7) of 6AW8A in the unit X47-0005-00 through a capacitor of $0.01\mu\text{F}$.
- 3) Shift the band select switch to 28MHz.
- 4) Detach the remote terminal of VFO.
- 5) Insert a ceramic capacitor of $0.01\mu\text{F}$ (500WV) between the earth and the cathode (pin 1) of V3 in the unit X48-0012-00.
- 6) Connect the filter detector to the TP2 terminals on the IF unit X48-0012-00.
- 7) Obtain such characteristic as shown in Fig. 7 by adjusting T6 (blue), T7 (black) and T8 (blue).
- 8) After detaching the capacitor of $0.01\mu\text{F}$ and filter detector, connect the TP1 and TP2 with solder.
- 9) Insert a connector into the remote terminal of VFO.

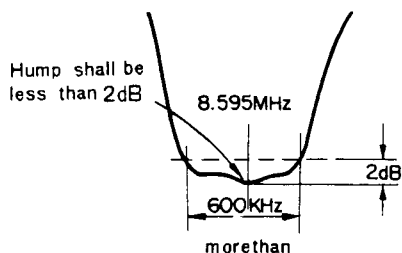


Fig. 7

3. IFT and Crystal filter (Refer to Fig. 5)

(1) Purpose:

To adjust the IFT to 3.395MHz and, to shape the wave form in the crystal filter.

(2) Measuring instruments and tools:

- 1) Sweep generator
- 2) Filter detector
- 3) After glow type oscilloscope
- 4) Regulating rod
- 5) Ceramic capacitor $0.01\mu\text{F}/500\text{WV}$

(3) Adjusting procedures:

- 1) Introduce the output of approximately 0.1V from the sweep generator to the first grid (pin No. 1) of 6BA6 (V1) in the unit X48-0012-00 through a capacitor of $0.01\mu\text{F}$.
- 2) Connect the AGC terminal to GND.
- 3) Connect the detector to the plate (pin No. 5) of 6BA6 (V4) located at the final stage of IF.
- 4) Speed up the sweeping speed to about 10 m-sec/cm. Adjust T3 and T4 while displaying the characteristic of IF stage on the oscilloscope. In this case, T4 must be adjusted by moving the upper and lower cores since it is an IFT for detection.
- 5) At this stage, slower the sweeping speed up to about 0.5 sec/cm and obtain such wave-form as shown in Fig. 8 by adjusting T1 and T2, while plotting the wave-form of crystal filter on the oscilloscope.
- 6) Minimize the ripple components by adjusting the 3.4MHz trap in T5 (white). If the wave-form is not nearly affected by T5 the core must be placed at the innermost position.
- 7) Disconnect the capacitor of $0.01\mu\text{F}$ and the detector and remove the AGC from GND.
- 8) While keeping watch on the S meter, retune the T3 to obtain a maximum of the S meter.

(4) Adjustment without slow sweeping

When the slow-sweeping can not be used, adjustment must be made as follows.

- 1) Receive an appropriate signal (SSG or marker produced inside the set) at nearly the center portion in the characteristic of filter detector.
- 2) Adjust every IFT so that the deviation of the S meter becomes maximum.
- 3) Fine adjustment for T3 and T4 must be made by moving slightly the main tuning knob to the left or the right in order to minimize (the deviation of S meter must be minimized) the ripple components of filter.
- 4) At this stage, perform adjustment described in Item 6), paragraph (3).

4. Zero adjustment of S meter

(1) Purpose:

To make a zero adjustment of the S meter's pointer, mechanically.

(2) No measuring instrument is necessary.

(3) Adjusting procedures

- 1) Connect the AGC terminal of the unit X48-0012-00 to GND.
- 2) Adjust the pointer to the zero point of Ip by means of ZERO ADJ (VR1) in the unit X48-0012-00.

[Note] Adjust precisely to "0" since the pointer deviates little toward the negative direction due to a diode.

- 3) Disconnect the AGC terminal from GND.
- 4) Ascertain that the meter pointer remains at a standstill even if the MODE switch is set to various different positions.
- 5) Ascertain that the pointer is deflected up to its full scale when the RF GAIN VR (VR2 in the front panel) is turned counterclockwise to the end. After this, it must be turned back to its initial position.

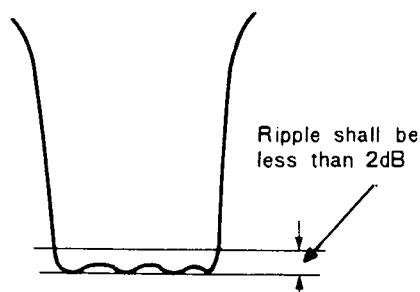


Fig. 8

5. Carrier oscillator (Refer to Fig. 9)

(1) Purpose:

To adjust the frequency of the carrier oscillator and to tune the output coil.

(2) Measuring instruments:

- 1) RF vacuum tube voltmeter or detector and voltmeter.
- 2) Frequency counter

(3) Adjusting procedures:

- 1) Connect the RF vacuum tube voltmeter to the OUT terminals in the carrier unit X50-0009-00.
- 2) Adjust the output coil T1 to obtain maximum output.
- 3) Disconnect vacuum tube voltmeter. Connect the frequency counter to the OUT terminal to make observation possible.
- 4) Match the frequency by adjusting the TC1 ~ 3 in accordance with Table 3.

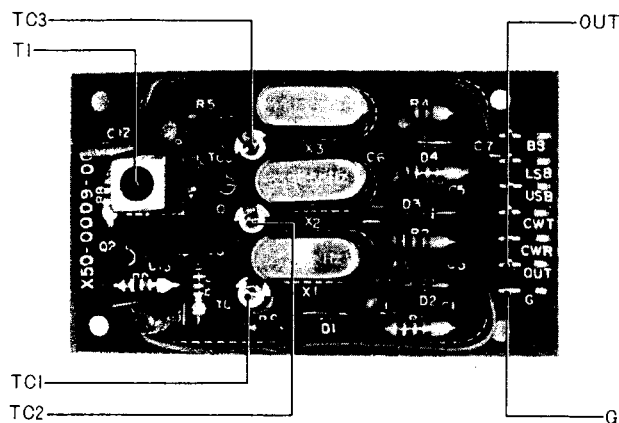


Fig. 9

Mode SW.	Receiving	Adjust	Transmitting	Adjust
USB	3.3965 MHz	TC2	3.3975 MHz	—
LSB	3.3935 MHz	TC3	3.3935 MHz	—
CW	3.3935 MHz	—	3.3943 MHz	TC1

Table 3

6. Coil pack

(1) Purpose:

To complete the RF tuning of an antenna in the coil pack.

(2) Measuring instruments:

- 1) Oscilloscope
- 2) AF vacuum tube voltmeter

(3) Adjusting procedures:

- 1) Connect the oscilloscope and the AF vacuum-tube voltmeter to a dummy load of 8 ohms in the PHONES terminal, thereby making observation possible.
- 2) Set the AGC/CAL switch to 25kHz.
- 3) Set the drive knob on the panel to the position of "12 o'clock". In this case, there should be no deviation of the knob at both sides.
- 4) Adjust the coil packs X44-0028-00 and X44-0027-00 in accordance with Table 4.

[Note 1] Adjustment may be impossible if the adjusting bands are not handled in correct order.

Tune the 3.5MHz L1 (X44-0028-00) core on the innermost side and the other cores on the outermost side.

[Note 2] Be careful not to destroy cores. If there is any care that fails to rotate smoothly, inject white powder (Acro-wax) and make sure that it rotates smoothly before adjusting it.

	Band SW.	VFO Frequency	X44-0028-00	X44-0027-00	Adjustment
1	3.5 MHz	3.750 MHz	L1	L1	Obtain the beat about 1kHz with the MARKER and VFO. Adjust the core so that maximum S meter indication or beat note can be obtained.
2	28.5 MHz	28.800 MHz	L5	L5	
3	21.0 MHz	21.225 MHz	L4	L4	
4	14.0 MHz	14.175 MHz	L3	L3	
5	7.0 MHz	7.150 MHz	L2	L2	

Table 4

7. 8.6MHz trap

(1) Purpose:

To improve IF rejection by adjusting 8.6MHz trap.

(2) Measuring instruments:

- 1) SSG
- 2) AF vacuum tube voltmeter
- 3) Oscilloscope

(3) Adjusting procedures:

- 1) Connect a dummy load of 8 ohms, AF vacuum tube voltmeter and oscilloscope to the PHONES terminal.
- 2) Set SSG frequency to 8.595MHz and introduce an input signal of 100dB to the REC ANT terminal.
- 3) Set the band select switch to 14MHz and the drive knob to the position of "12 o'clock"
- 4) Locate the VFO calibration around "300" and obtain a beat output and adjust 8.6MHz trap so as to make its output minimum.

8. Beat interference

(1) Purpose:

To minimize the beat interference by adjusting the trap coil and VFO.

(2) Measuring instruments:

- 1) SSG
- 2) AF vacuum tube voltmeter
- 3) RF vacuum tube voltmeter
- 4) Oscilloscope

(3) Adjusting procedures:

- 1) Connect the RF vacuum tube voltmeter to the cathode (pin 2) of RX mixer 6CB6 (V3) in the unit X48-0012-00 through a capacitor of 0.01 μ F and then adjust the VFO output to 0.8 volt by the trimmer located inside the VFO at approximately "300" of the VFO calibration.
- 2) Remove the capacitor of 0.01 μ F.
- 3) Obtain a beat at around 3.75MHz and an output of 0.63 volt (50mW/8 ohms) at the PHONES terminal.
- 4) Adjust T1 (orange) on the IF unit X48-0012-00 to obtain a lower beat interference output when compared with the output obtained by the application of the signal (3.75MHz) of 3dB from SSG to the REC ANT terminal.

9. Carrier balance (Refer to Fig. 10)

(1) Purpose:

To prevent the signal of carrier oscillator from flowing into the IF stage through a balanced detector.

(2) Measuring instruments:

- 1) SSG
- 2) Oscilloscope
- 3) AF vacuum tube voltmeter

(3) Adjusting procedures:

- 1) Tuning must be taken so as to assure a maximum deflection of S meter while receiving the output (14.2MHz) of 30dB from SSG.
- 2) Adjustment must be made to assure a minimum deflection of S meter by tuning alternatively the trimmer TC2 (40pF) on the generator unit and the semi-fixed resistor VR3 (1k Ω).

[Note] If no measuring instrument is available, use the built-in marker.

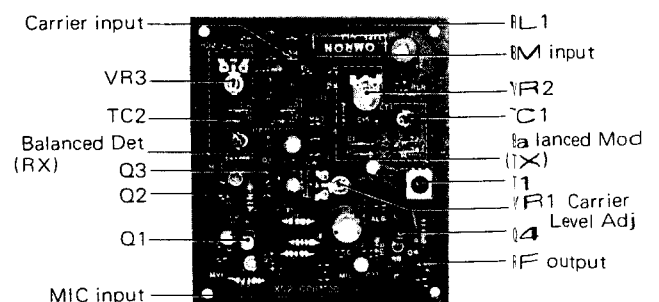


Fig. 10

10. S meter sensitivity

(1) Purpose:

Adjust the pointer of S meter to S9 with specified input.

(2) Measuring instrument:

SSG

(3) Adjusting procedures:

- 1) Check that the RF GAIN VR (VR2) is set to fully clockwise position.
- 2) Set the BAND to 14MHz and apply a 14.2MHz 30dB SSG signal from the REC ANT terminals and establish the tuning of DRIVE and VFO (signal is not modulated).
- 3) Adjust the SENSI VR (VR2) of S meter mounted on the unit X48-0012-00 so that the deflection of S meter will point to S9.
- 4) Set the RF GAIN VR (VR2) to fully counterclockwise position.
- 5) Turn the VR attached to the SM terminal disposed at the rear of the IF unit to locate the pointer of S meter at the first portion of letter "mA" located near its full scale.
- 6) Again, set the RF GAIN VR to fully clockwise position and check that the meter is pointing to S9.

[Note] After completing the abovementioned adjustment, check for "leak of carrier".
The "leak of carrier" must be checked by following procedure since it sometimes occurs, depending on the carrier position or the wave form unbalance of the filter (X-1).

- After finishing the adjustment by 8-(3)-3), rotate the RF GAIN VR counterclockwise slowly and hold it at a point just before the indication of S meter increases beyond S9.
- Next, turn off the SSG output and check that the S meter gives an indication of more than S7.
- Place the RF GAIN VR in fully clockwise position.

11. RIT

(1) Purpose:

To adjust the transmitting frequency to the center (zero point) of the RIT knob.

(2) Measuring instruments:

- 1) AF generator
- 2) Oscilloscope

(3) Adjusting procedures:

- 1) Set the function of the oscilloscope to EXT HORIZONTAL and introduce the output (1kHz, 1V) of AF generator to the H terminal.
- 2) Set the RIT knob (VR3 on the surface of panel) to exactly "0" and pull the RF GAIN VR switch out.
- 3) Receive the marker at 14.2MHz and obtain a beat sound of about 1kHz. In this case, a signal must be received with a maximum sensitivity by adjusting the knobs at respective stages.
- 4) Introduce the received output to the V terminal of oscilloscope and adjust the VFO dial finely until the Lissajous' figure stops. In this case, the figure should be a circle.
- 5) Push in the RF GAIN VR knob to set the RIT to off and adjust the RIT "0" ADJ VR (VR2) on the unit X43-0010-00 so that the Lissajous' figure of the oscilloscope will become a circle again.

[Note] The adjustment of Item 5) must be finished with one minute. If it cannot be made within this period, readjustment must be made from Item 4).

- 6) Set the marker to "OFF" and then disconnect the AF generator and the oscilloscope.

Marker

- (1) **Purpose:**
Adjust the oscillation frequency of crystal.
- (2) **Measuring instrument:**
Frequency counter.
- (3) **Adjusting procedures:**
 - 1) Connect the counter between the MO terminal of the unit and the GND terminal.
 - 2) Set the AGC/CAL switch to 25kHz and rotate the trimmer TC1 on the unit so that the reading of counter is set to 25kHz \pm 2Hz.

Setting of base current (Refer to Fig. 11)

- (1) **Purpose:**
Adjust the base current to the power transistor in the AF unit under the absence of input signal.
- (2) **Measuring instrument:**
DC ammeter or circuit tester with a calibration of about 100mA in full scale.
- (3) **Adjusting procedures:**
 - 1) Disjoint the red - white lead wire connected to the terminal "14" on the AF unit (Power switch must be in off condition).
 - 2) Connect the ammeter between the red - white lead wire and the terminal "14" (lead wire (+), terminal (-)).
 - 3) Turn on the power switch. But, the AF-GAIN VR must be turned fully counterclockwise (minimum sound volume).
 - 4) Set the current to 42mA by turning the PC trimmer potentiometer (VR1) in the AF unit.

[Note] Check that the line voltage is exactly AC 117 volts.

 - 5) Remove the ammeter and restore wiring connection.

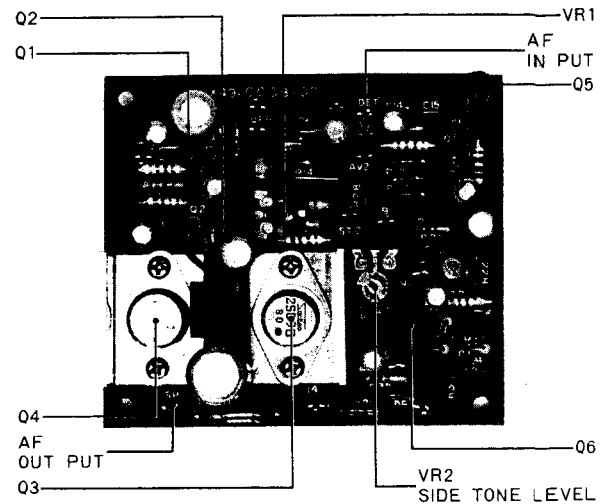


Fig. 11

■ ADJUSTMENTS OF TS- 515 TRANSMIT SECTION

1. Final bias

(1) Purpose:

To set the final base current.

(2) No measuring instrument is necessary.

(3) Adjusting procedures:

- 1) Connect the OUT terminal of the carrier unit to the earth with the capacitor of $0.01\mu\text{F}$.
- 2) Set the drive knob to the position of "9 o'clock".
- 3) Set the MODE switch to L S B, the BAND select switch to 14MHz and the STAND-BY switch to SEND.
- 4) Set the METER switch to I_p and then adjust the BIAS VR (VR5) to obtain $I_p = 60\text{mA}$.
- 5) Return the STAND-BY switch to REC position and remove the $0.01\mu\text{F}$ capacitor which is shortening the out terminal of the carrier unit.

2. Adjustment of IFT in the BM stage and carrier level.

(1) Purpose:

To adjust the IFT (3.395MHz) in the BM stage and set the carrier level of CW.

(2) No measuring instrument is necessary:

(3) Adjusting procedures:

- 1) Turn off the SG SW mounted on the rear of the set.
- 2) Turn the MODE switch to CW.
- 3) After setting the BAND select switch to 14MHz and the VFO to 14.175MHz, the drive knob must be set to the position of "12 o'clock".
- 4) Set the meter change over switch and the STAND-BY switch to ALC and SEND, respectively, and rotate the DRIVE knob to obtain the maximum ALC output.
- 5) Adjust T1 of the generator unit (X52-0010-00) from the rear side of the chassis to obtain the maximum ALC output.
- 6) Check that no ALC signal is present if the drive knob is rotated fully clockwise.
- 7) Connect the RF vacuum tube voltmeter (1 volt range) directly or through a capacitor of $0.01\mu\text{F}$ to the first grid of the transmitting mixer 6CB6 (V2) in the IF unit and adjust the variable resistor VR1 ($50k\Omega$) on the generator unit so as to obtain the meter indication of 0.75V.

3. Adjustment of the RF meter sensitivity

(1) Purpose:

To adjust the RF meter sensitivity.

(2) Measuring instrument:

RF dummy or power meter (more than 200 watts).

(3) Adjusting procedures:

- 1) Connect the power meter to the ANT terminal.
- 2) Turn on the SG SW placed at the rear of the set.
- 3) Set the mode switch to CW.
- 4) Set the BAND switch and plate knob to 14 and also the VFO to 14.175MHz.
- 5) Set the meter change switch to I_p .
- 6) Set the STAND-BY switch to SEND and adjust the drive knob to obtain and maximum level of I_p .
- 7) Return the STAND-BY switch to REC and wait for several seconds.
- 8) Set again the STAND-BY switch to SEND and adjust quickly the plate knob to take a dip of I_p .
- 9) Reset the STAND-BY switch to REC.
- 10) Set the meter change over switch to the RF position.
- 11) Set the STAND-BY switch to SEND and adjust the plate and the load knob alternatively to obtain the maximum output (maximum indication) of the RF meter (check that the output more than 150 watts).
- 12) Under this condition, adjust the RF variable resistor mounted on the rear surface so that the indication of RF meter will become about 400mA in I_p scale.
- 13) Reset the STAND-BY switch to REC.
- 14) Put the cap on the RF variable resistor.
- 15) Shift the BAND select switch to 3.75MHz and then adjust each knob to obtain the output of more than 150 watts.
- 16) In similar manner, check that the outputs at 7.15MHz and 21.225MHz exceed 150 watts.
- 17) In the same way, ascertain that the outputs at 28.3MHz, 28.8MHz and 29.4MHz exceed 120 watts.

- [Note]
- Ventilation by a fan must be complete during transmission.
 - Turning must be made quickly and completely.
 - Continuous transmission for more than 10 seconds by CW is not permitted.

4. Adjustment of neutralization

(1) Purpose:

To stabilize operation by neutralizing the final stage.

(2) Measuring instruments:

- 1) RF dummy or power meter
- 2) RF vacuum tube voltmeter

(3) Adjusting procedures:

- 1) Connect the dummy or the power meter to the ANT terminal.
- 2) Obtain the maximum output at a frequency of 21.3MHz (CW).
- 3) Set the STAND-BY switch to REC and cut off screen voltage by the SG switch mounted on the rear panel of the set.
- 4) Connect the RF vacuum tube voltmeter to the ANT terminal and set the STAND-BY switch to SEND and then adjust a neutralizing variable capacitor (TC1) positioned at the final shield box so as to minimize the pointer deflection of the RF voltmeter.
- 5) Return the STAND-BY switch to REC and disconnect the RF vacuum tube voltmeter and restore the SG switch.
- 6) Set the switch to SEND again the ascertain that the power is available as before.
- 7) Return the switch to REC.

- [Note]
- Be careful not to touch by the hand since the plate line is always provided with high voltage (800V).
 - Continuous transmission for more than 10 seconds by CW is not permitted.
 - Tubes at the final stage must be brought into an inoperative condition with a ratio of 3 to 1 against all the transmission time.
 - When the RF vacuum tube voltmeter is not used, any type of receiver of being able to receive a 21MHz band may be used.

5. BM and carrier position (Refer to Fig. 12, 13)

(1) Purpose:

To adjust the carrier position by balancing the balanced mixer.

(2) Measuring instruments:

- 1) AF generator
- 2) AF vacuum tube voltmeter
- 3) RF dummy or power meter
- 4) RF vacuum tube voltmeter

(3) Adjusting procedures:

- 1) Connect a dummy load of 75 ohms and the RF vacuum tube voltmeter to the ANT terminal.
- 2) Set the MODE switch to CW and the frequency to 14.2MHz and adjust each knob so that a maximum power can be obtained.
- 3) Next, set the MODE switch to LSB and adjust the balancing VR (VR2) and trimmer (TC1)

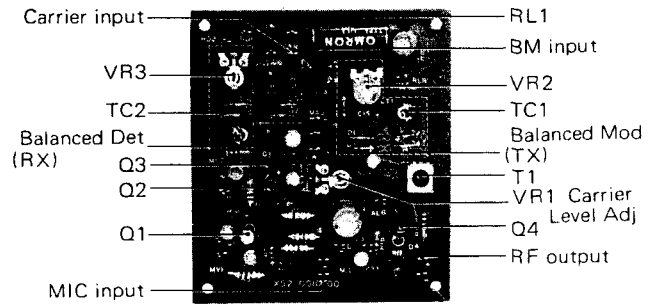


Fig. 12 X52-0010-00

in the unit X52-0010-00 so that the RF vacuum tube voltmeter will give a minimum indication.

- 4) Apply 7mV, 1500Hz AF signal to the MIC terminal while setting the range of RF vacuum tube voltmeter to the maximum voltage position and obtain an output of 50 watts by adjusting the MIC GAIN VR (VR6).
- 5) At this stage, shift the frequency of AF signal to 400Hz and then to 2600Hz and perform fine adjustment of the trimmer TC3 mounted on the carrier unit X50-0009-00 to regulate the difference of their outputs within 5 watts.

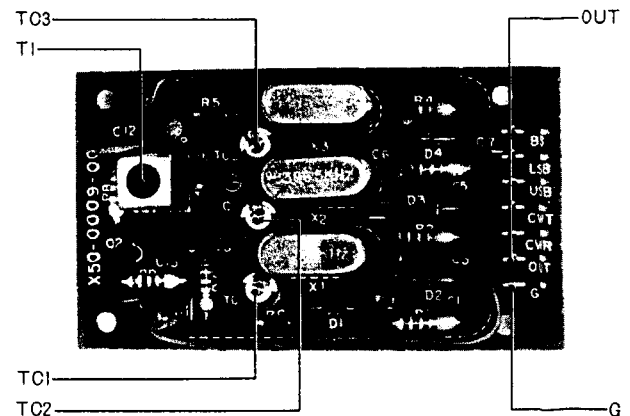


Fig. 13 X50-0009-00

- 6) Set the MODE switch to USB and shift AF signal to 400Hz and 2600Hz and perform fine adjustment of the trimmer (TC2) mounted on the carrier unit X50-0009-00 to regulate the difference of their outputs within 5 watts.
- 7) Disconnect the AF generator from the MIC terminal and rotate the MIC GAIN VR fully counterclockwise.
- 8) Set again the MODE switch to LSB and adjust the balancing VR2 and trimmer (TC1) in the unit X50-0010-00 so that the RF vacuum tube voltmeter will give a minimum indication (similar operation to Item 3).

- 9) Set the MODE switch to USB. If the indication of the RF vacuum tube voltmeter increases, the variable resistor (VR) and the trimmer must be adjusted to points where the RF vacuum tube voltmeter at USB and LSB give the same minimum indication. This indication is referred to as A. (If the indication of the RF vacuum tube voltmeter decreases when the MODE switch is shifted from LSB to USB, readjustment by the variable resistor (VR2) and the trimmer (TC1) is not required. In this case the indication at LSB is referred to as A).
- 10) Set the ATT of the RF vacuum tube voltmeter to its maximum condition.
- 11) Apply 7mV, 1500Hz AF signal to the MIC terminal and check that the power of more than 80 watts is available. The indication of the RF vacuum tube voltmeter is referred to as B.
- 12) Ascertain that the difference between two indications "A" and "B" exceeds 40dB.

- [Note]
- Continuous transmission for more than 10 seconds is not permitted.
 - Tubes at the final stage must be brought into an inoperative condition with a ratio of 3 to 1 against all the transmission time.
 - Ventilation by a fan must be complete during transmission.
 - Instead of the RF vacuum tube voltmeter, any type of S meter of the receiver being able to receive 10MHz may be used. In this case, it must be used near the RF dummy and by connecting a lead wire to the receiver antenna.
 - In case no measuring instrument is available, adjustment must be made in accordance with the instruction manual.

6. Side tone

(1) Purpose:

To set the output level of side tone and to check semi-break-in operation.

(2) Measuring instruments and tools:

- 1) RF dummy or power meter
- 2) AF vacuum tube voltmeter
- 3) Oscilloscope
- 4) Key
- 5) 8 ohms dummy

(3) Adjusting procedures:

- 1) Connect a dummy to the ANT terminal and also the AF vacuum tube voltmeter with a dummy of 8 ohms and the oscilloscope to the PHONES terminal.
- 2) Set the STAND-BY switch and the MODE switch to SEND and CW, respectively. Obtain

the maximum power at 14.2MHz by adjusting each knob.

- 3) Ascertain that high frequency output is reduced to zero when the key is inserted into the key jack.
- 4) Check that the same power is available as before when the key is pushed. After this, adjust the side tone variable resistor (VR2) mounted on the unit X49-0008-00 so that the power of 5mW ($0.2V/8\Omega$) is available as side tone AF output.
- 5) Check that the semi-break-in keying is possible when the key is pushed after setting the STAND-BY switch to VOX.

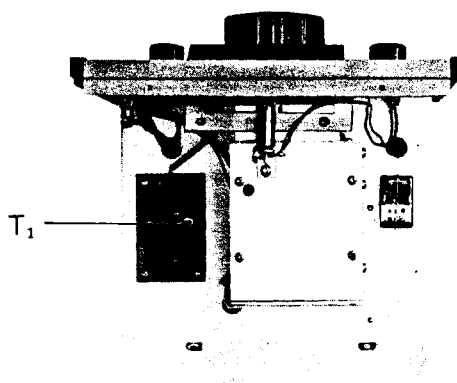


Fig. 14

■ ADJUSTMENTS OF VFO-5S

1. Adjustment of crystal oscillation (Refer to Fig. 14)

When the device does not oscillate with a crystal oscillator having a frequency characteristic of 5.5~4.9 MHz, the ceramic trimmer T1 must be adjusted. If it does not still start oscillation owing to defect of the crystal oscillator or inherent unsuitable matching to the circuit, a new crystal oscillator must be purchased with circuit designation.

Oscillating condition must be judged by the deflection of the RF meter after putting TS-515 into the state of transmitting. In this case, a dummy load must be connected to ANT without fail.

2. Matching of frequency

(1) Purpose:

To perform frequency tracking of VFO unit.

(2) Measuring instrument:

Frequency counter.

(3) Adjusting procedures:

- 1) Connect the main body and the unit VFO-5S by the attached VFO cable.
- 2) Throw down the VFO crystal change over switch to VFO side.
- 3) Set the function switch to REC or REC/XMIT.
- 4) Set the RIT knob to the RIT off position.
- 5) Turn on the power switch on the main body.
- 6) Connect the frequency counter to the output terminal of the VFO unit.
- 7) Tune to 5.5MHz by rotating the tracking variable capacitor in the VFO unit at "0" in calibration.
- 8) At this stage, tune to 4.9MHz by rotating the core of coil in the unit at "600" in calibration.
- 9) Obtain the output of 5.5MHz ± 1.7 kHz and 4.9MHz ± 1.7 kHz at the calibration "0" and "600", respectively, by repeating the adjustment specified by Items 7) and 8) for several times.

3. RIT

(1) Purpose:

To adjust the transmitting frequency to the center (zero point) of the RIT knob.

(2) Measuring instruments:

- 1) AF generator
- 2) Oscilloscope

(3) Adjusting procedures:

- 1) Remove the case of the unit VFO-5S in accordance with Item 4, relative to maintenance.

- 2) Connect the main body and the unit VFO-5S by the attached VFO cable.
- 3) Turn on the power switch on the main body.
- 4) Throw down the VFO-crystal change over switch to VFO side.
- 5) Set the function switch to REC or REC/XMIT.
- 6) Adjust the RIT knob of the unit VFO-5S to the "0" position exactly.
- 7) Set the AGC/CAL switch in the main body to 25kHz.
- 8) Receive the marker at 14.2MHz by turning the dial in the unit VFO-5S and obtain a beat sound of about 1000Hz.
In this case, receive a signal at its maximum sensitivity by adjusting the knob at each stage.
- 9) Set the function of the oscilloscope to EXT HORIZONTAL and introduce the AF generator output (1000Hz, 1V) to the H terminal.
- 10) Introduce the received output to the V terminal of the oscilloscope and adjust the VFO dial finely until the Lissajous' figure stops. In this case, the figure should be a circle.
- 11) Set the RIT knob of the unit VFO-5S to OFF and adjust the RIT VR 10k Ω (VR2) within the chassis of VFO-5S so that the Lissajous' figure of the oscilloscope will become a circle again.

[Note] Adjustment specified by Item 11) must be finished within one minute. If it cannot be made within this period, readjustment must be made from Item 10).

4. Maintenance

(1) Remove the case

Remove two screws on the surface of the upper panel and four screws on the bottom surface. The front panel must be quietly pulled out of place. The removal of leg portion of leg portion is not required.

Be careful since it often results in frequency deviation and the cause of drift if the case is dissolved unnecessary.

(2) Lubrication to gear portion

A small quantity of machine oil must be applied once a year to dial gears.

(3) Pilot lamp

The pilot lamp must be provided with a ϕ 4mm base of 12V/1.5W.

■ LEVEL DIAGRAM OF TS-515

1. Receiver

Fig. 16 shows a level diagram in the receiving portion.

- [Note]
- Each value in Fig. 16 shows the attenuator reading of SSG taken when the pointer of S meter starts to move slightly from "0".
 - The values indicated by V_{rms} show the measured values by the RF vacuum tube voltmeter.
 - Before the receiver portion is checked, the null-point must be surely set by variable resistor of S meter on the IF unit.
 - As shown in Fig. 15 SSG must be used with a ceramic capacitor of 0.01 μ F (500WV).

2. Transmitter portion

Fig. 17 shows a level diagram in the transmitter portion.

- [Note]
- Each value in Fig. 17 shows the measured value by the RF vacuum tubes voltmeter having an input capacitance of less than 3pF.
 - Voltage up to the first grid of S2001 show the values measured under the condition the SG switch is in OFF.
 - Voltages with no special note show the values in rms.
 - The values with mark * include the heterodyne input voltages and signal voltages.
 - Set the MODE switch to the position "CW".

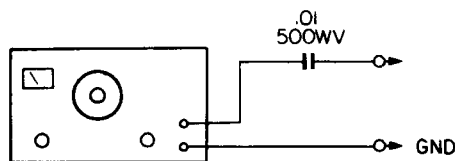


Fig. 15

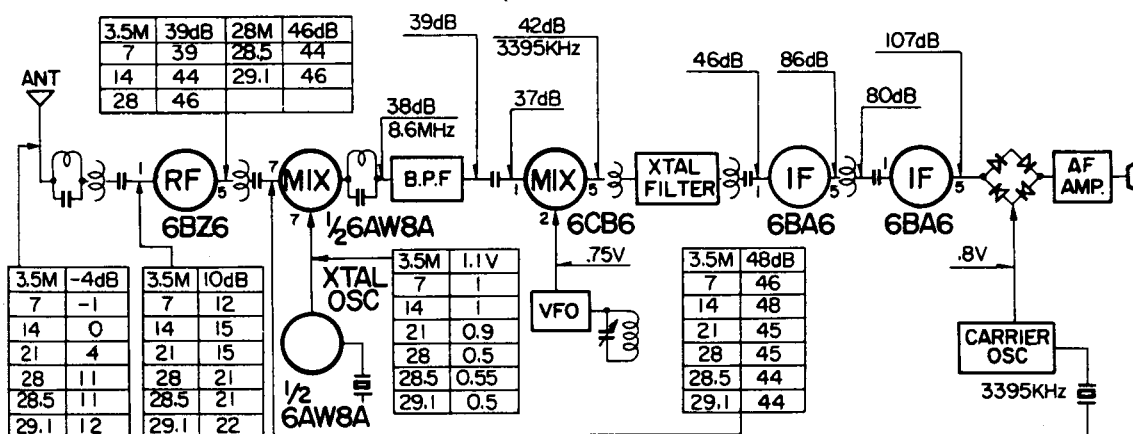


Fig. 16

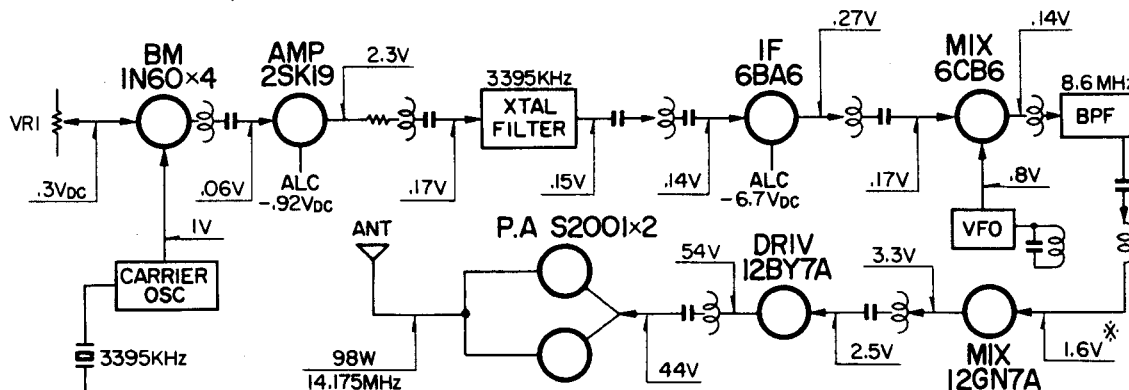
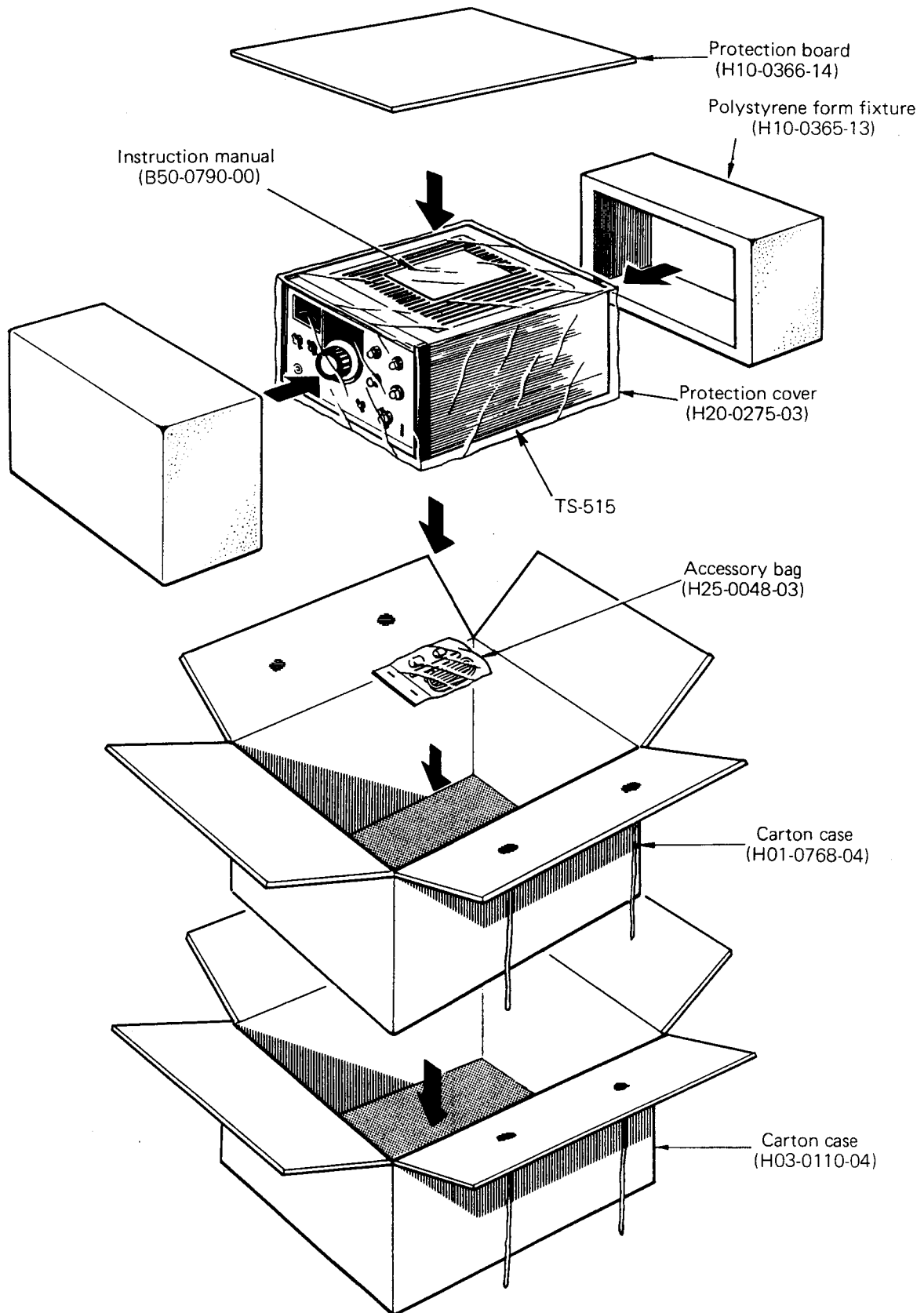


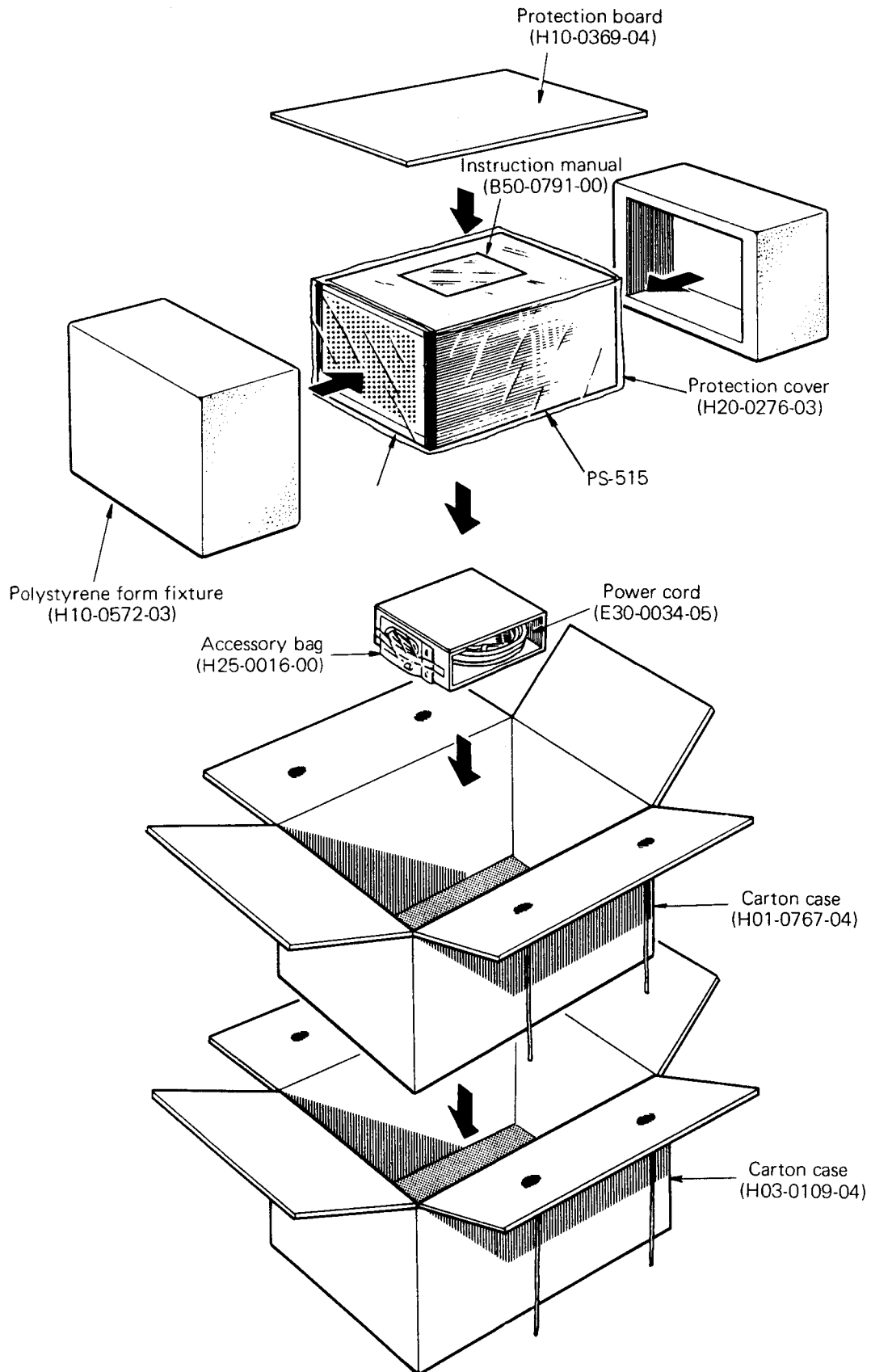
Fig. 17

PACKING

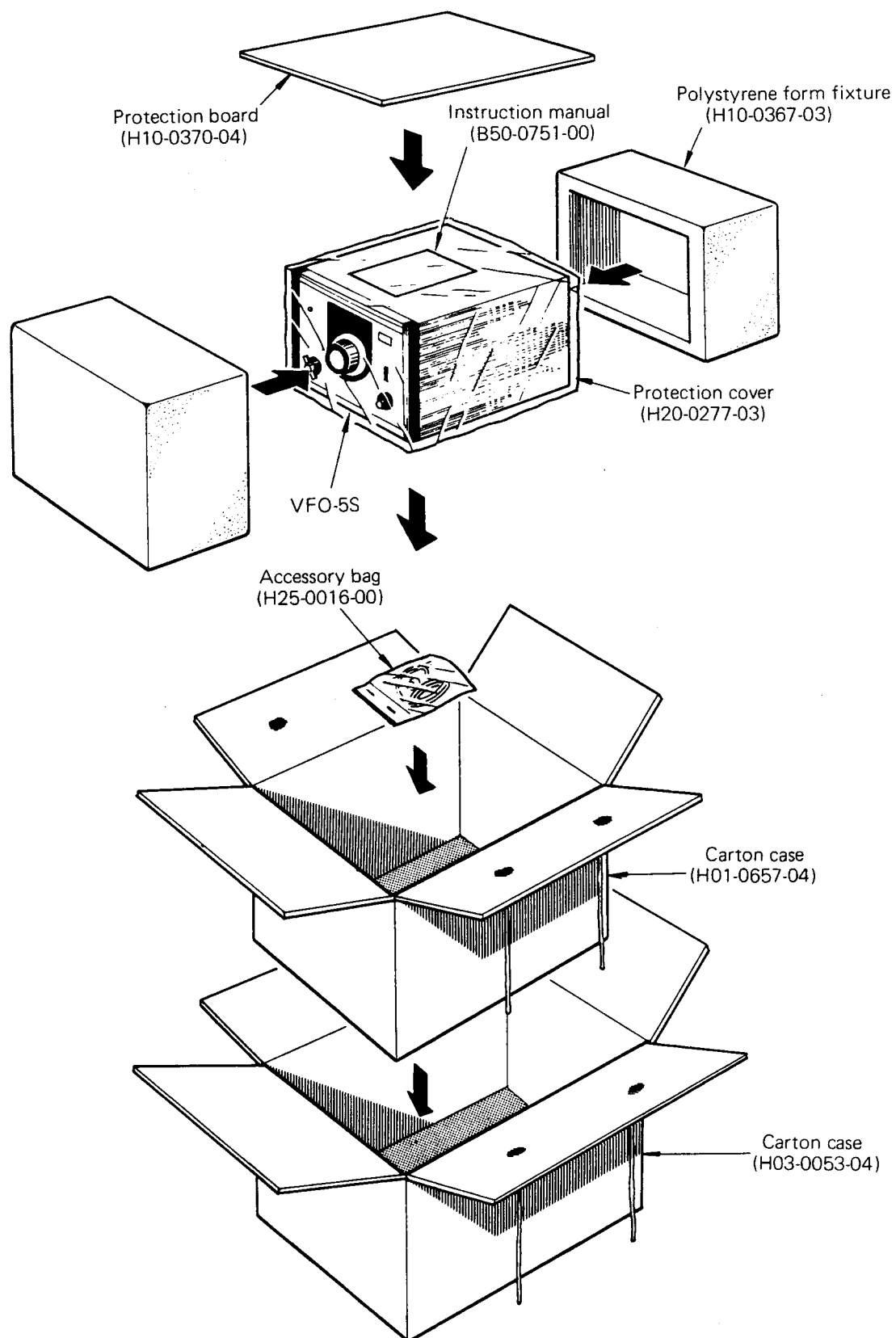
■ PACKING TS-515



■ PACKING PS-515



■ PACKING VFO-5S



PC BOARD & PARTS LIST

■ PARTS LIST OF TS-515 (Y54-0019-10)

Circuit No.	Parts No.	Description	Remarks
UNIT			
—	X40-0016-02	VFO UNIT	
—	X43-0010-01	AVR UNIT	
—	X44-0026-00	OSC COIL PACK UNIT	
—	X44-0027-00	MIX COIL PACK UNIT	
—	X44-0028-00	DRIV COIL PACK UNIT	
—	X47-0005-00	DRIVER UNIT	
—	X48-0012-00	IF UNIT	
—	X49-0008-00	AF UNIT	
—	X50-0009-00	CARRIER UNIT	
—	X52-0005-01	MARKER UNIT	
—	X52-0010-00	GENERATOR UNIT	
—	X53-0002-00	CONTROL UNIT	
—	X54-0001-01	VOX UNIT	
—	X56-0004-03	FINAL UNIT	
CAPACITOR			
C1	CE04W1E221	PC electrolytic 220 μ F 25WV	
C2, 3	C90-0086-05	Electrolytic block 1000 μ F x 2 25WV	
C4 ~9	CK94YZ2H103P	Ceramic 0.01 μ F +100%, -0%	
RESISTOR			
R1	RN14AB3T562J	Metal film 5.6k Ω \pm 5% 7W	
R2	RC05GF2H680K	Carbon composition 68 Ω \pm 10% 1/2W	
R3	RC05GF2H103K	Carbon composition 10k Ω \pm 10% 1/2W	
R5	RC05GF2H333K	Carbon composition 33k Ω \pm 10% 1/2W	
R6	RC05GF2H563K	Carbon composition 56k Ω \pm 10% 1/2W	
R7	RC05GF2H105K	Carbon composition 1M Ω \pm 10% 1/2W	
R101, 102	PD14BY2E103J	Insulated carbon film 10k Ω \pm 5% 1/4W	
POTENTIOMETER			
VR1	R03-4030-05	AF · GAIN 50k Ω (A)	
VR2	R03-3046-05	RF · GAIN 10k Ω (C)	
VR3	R03-2028-05	RIT 5k Ω (B)	
VR4, 5	R03-3024-05	RM · BIS 10k Ω (B)	
VR6	R02-3005-05	MIC 10k Ω (A)	
VR7	R02-6001-15	TIM 250k Ω (B)	
VR8	R02-4002-15	VOX 50k Ω (B)	
VR9	R02-0001-15	AVX 300 Ω (B)	
SEMICONDUCTOR			
D1		RD-9AM	
D2		S-1.5-02	
D3, 4		10D-1	
D101, 102		1S84	
SWITCH			
S1	S29-1048-05	Rotary (METER)	
S2	S04-2025-05	Rotary (AGC)	
S3	S04-3008-05	Rotary (MODE)	
S4	S31-2007-05	Slide	
MISCELLANEOUS			
—	A01-0131-01	Case	

Circuit No.	Parts No.	Description	Remarks
—	A10-0246-21	Chassis	
—	A20-0493-02	Panel assembly	
—	A40-0063-02	Bottom plate	
—	B01-0034-04	Side escutcheon (A)	
—	B01-0035-04	Side escutcheon (B)	
—	B03-0030-04	Dial back board	
—	B07-0067-04	Meter escutcheon	
—	B07-0068-03	VFO escutcheon	
—	B07-0069-04	Lever switch escutcheon	
—	B19-0100-04	Acrylboard (A)	
—	B19-0093-04	Acrylboard (B)	
—	B20-0179-14	Dial board	
—	B30-0007-05	Pilot lamp x 2	
—	B31-0117-05	Meter	
—	B41-0107-04	Voltage indication plate	
—	B42-0240-04	Name plate	
—	B42-0241-04	Name plate (VOLUME)	
—	B42-0009-04	Passed sticker	
—	B50-0790-00	Instruction manual	
—	D13-0032-03	Pulley x 4	
—	D16-0020-04	Chain assembly x 2	
—	D16-0021-04	Chain assembly x 2	
—	D21-0075-04	Dual shaft	
—	D21-0076-04	Drive shaft	
—	D21-0166-05	Shaft	
—	D23-0048-04	Bearing x 3	
—	D23-0061-04	Bearing x 3	
—	D32-0018-04	Shaft stopper x 3	
—	E01-0801-05	US socket	
—	E01-0903-05	9 pin miniature socket	
—	E05-0901-05	9 pin plug	
—	E06-0403-05	4P mic socket	
—	E07-0403-05	4P mic plug	
—	E08-1202-05	12P plug socket	
—	E09-0203-05	2P plug	
—	E11-0005-05	3P switchcraft jack	
—	E11-0014-05	US jack	
—	E14-0801-05	US plug	
—	E15-0010-05	Pilot lamp holder	
—	E15-0012-15	Socket	
—	E18-1201-05	Relay socket	
—	F10-0193-14	Shield plate (coil) x 2	
—	F10-0194-04	Shield plate (coil pack)	
—	H01-0768-04	Carton case	
—	H03-0110-04	Carton case	
—	J02-0005-04	Sub legs x 2	
—	J02-0010-04	Legs x 4	

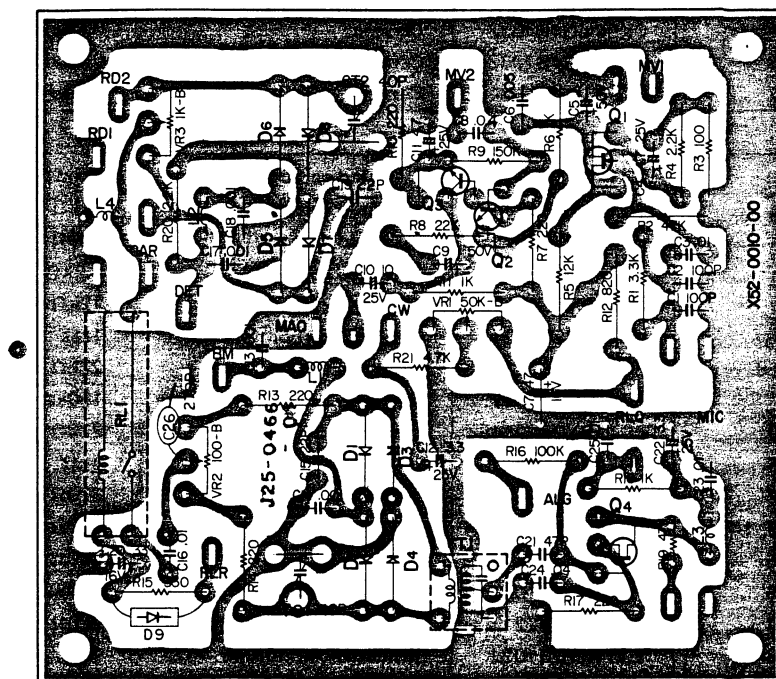
Circuit No.	Parts No.	Description	Remarks
—	J12-0048-05	Relay clamp	
—	J20-0155-03	Side angle	
—	J21-0719-04	Dial stopper	
—	J21-0720-14	Meter stopper	
—	J21-0721-04	Volume stopper	
—	J59-0001-05	Glomet x 2	
—	J59-0002-05	Plunger x 2	
—	J25-0601-04	PC board	
—	K20-0064-04	Knob (LOAD)	
—	K21-0057-04	Knob (DRIVE) x 3	
—	K21-0234-04	Knob (PLATE)	
—	K21-0235-04	Knob (METER) x 4	
—	K21-0236-03	Knob (BAND)	
—	K21-0237-03	Knob (MAIN)	
—	K23-0057-04	Knob (VOX) x 4	
—	K29-0069-04	Thumb collar	
CH	L15-0002-15	Choke coil	
—	L31-0141-05	IF trap coil	
L101 ~ 105	L33-0104-05	Ferri-inductor	
—	N08-0070-04	Terminal	
RL1	S51-4016-05	Relay	
—	S47-2001-05	Lever switch	
—	W01-0005-04	Test rod	

■ PARTS LIST OF (X56-0004-03)

Circuit No.	Parts No.	Description				Remarks	
CAPACITOR							
C1 ~ 6	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%		
C7, 8	CK94YZ2H103P	Ceramic	0.01μF	+100%	−0%		
C9	CK94YY3A103M	Ceramic	0.01μF	±20%			
C10	C90-0009-05	Ceramic	1000pF	±10%			
C11	CM91F3A151K	Mica	150pF	±10%			
C12	CM91F3A801K	Mica	800pF	±10%			
C13	CM93F2H330J/ DM-15	Mica	33pF	±5%			
C14	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%		
C15 ~ 17	CK94YZ2H103P	Ceramic	0.01μF	+100%	−0%		
C18	CM91F3A251J	Mica	250pF	±5%			
C19, 20	CK94YZ2H102P	Ceramic	0.001μF	+100%	−0%		
C21	C90-0097-05	Ceramic	100pF				
C22	C90-0098-05	Ceramic	68pF				
C23	CM91F3A251J	Mica	250pF	±5%			
C24	CK94YZ2H102P	Ceramic	0.001μF	+100%	−0%		
VC1	C03-0044-05	Variable capacitor					
VC2	C01-0083-05	Variable capacitor					
TC1	C03-0002-05	Ceramic trimmer					
RESISTOR							
R1, 2	RC05GF3A2R2J	Carbon composition	2.2Ω	±5%	1W		
R3, 4	RC05GF2H101K	Carbon composition	100Ω	±10%	1/2W		
R5 ~ 7	PD14BY2H684J	Insulated carbon film	680kΩ	±5%	1/2W		
R8	PD14BY2E104J	Insulated carbon film	100kΩ	±5%	1/4W		
R9	PD14BY2E102J	Insulated carbon film	1kΩ	±5%	1/4W		
R10	RN14AB3D103J	Metal film	10kΩ	±5%	2W		
TUBE/SEMICONDUCTOR							
V1, 2		S-2001					
D1		1N60					
COIL							
L1	L33-0098-05	Ferri-inductor x 2					
L2	L33-0104-05	Ferri-inductor					
L3	L33-0032-05	Heater choke (3μH)					
L4	L33-0048-05	Choke coil					
L5	L31-0186-05	Final coil B (28 MHz)					
L6	L31-0142-05	Final coil A					
L7, 8	L33-0025-05	Heater choke (1μH)					
L9	L33-0101-05	Ferri-inductor					
PS1, 2	L33-0010-05	Parasitic suppressor coil					
PS3, 4	L39-0030-04	Parasitic suppressor coil					

Circuit No.	Parts No.	Description	Remarks
MISCELLANEOUS			
—	A10-0230-03	Chassis	
—	B42-0287-04	High voltage caution plate	
—			
—	D12-0041-05	Rotary cam	
—	D13-0028-04	Bevel gear	
—	D22-0004-04	Shaft coupling	
—	D22-0005-04	Shaft coupling	
—			
—	E01-0801-05	US socket	
—	E01-0902-05	Socket	
E1	E04-0115-05	M type receptacle	
E3	E08-0203-25	2P plug socket	
E2	E13-0104-05	1P jack	
—	E18-1201-05	Relay socket	
—	E20-0510-05	Terminal strips	
—	E90-0004-15	Plate cap x 2	
—			
—	F07-0186-63	Cover	
—	F11-0117-03	Box	
—	F11-0118-24	Relay shield plate	
—			
—	J21-0468-04	Bobbin angle	
—	J21-0725-04	Rotary switch stopper	
—	J21-0747-14	Fan stopper	
S1	S10-1091-05	Rotary switch	
S2	S31-2007-05	Slide switch	
RL1	S51-4017-05	Relay	
—	T40-0009-05	Motor (with fan)	

■ PC BOARD OF X52-0010-00



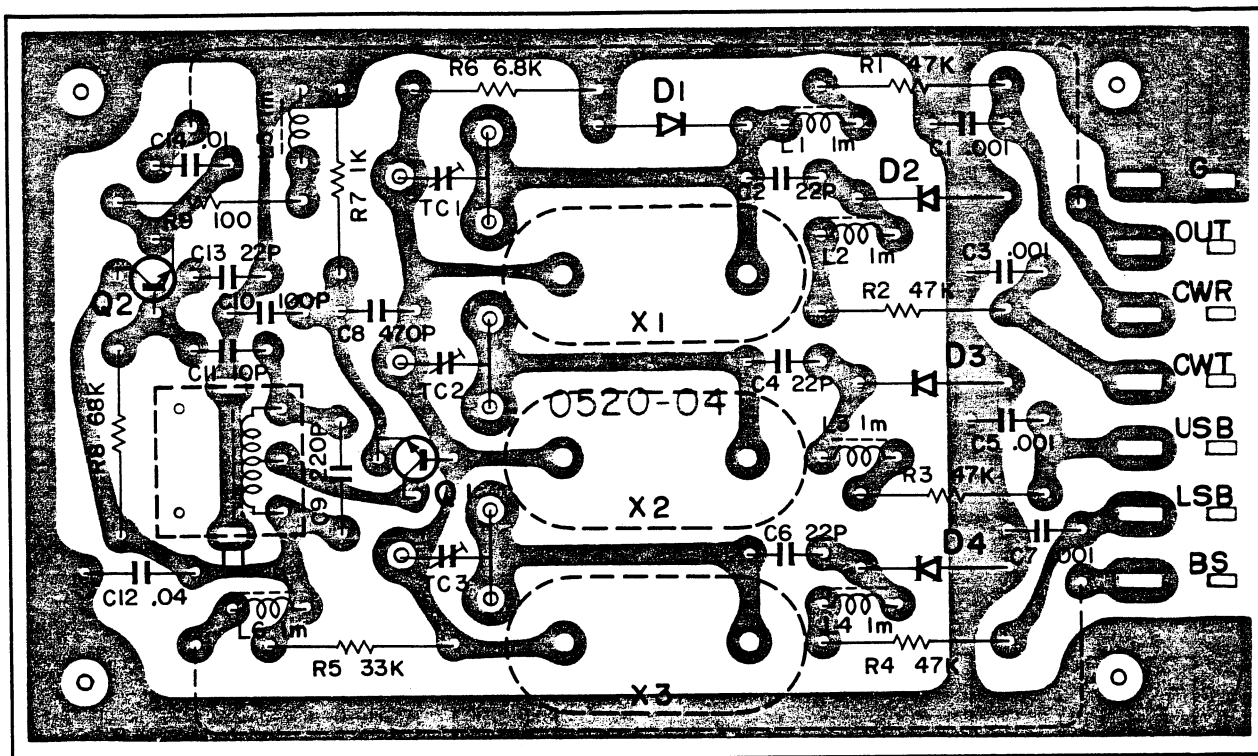
Q1: 2SK24(E), Q2 ~ Q3: 2SC733(Y), Q4: 2SK19(GR), D1 ~ D9: 1N60

■ PARTS LIST OF X52-0010-00

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1, 2	CC94SL1H101K	Ceramic	100pF	±10%		
C3	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	
C4	CE04W1E4R7	PC electrolytic	4.7μF	25WV		
C5	CE04W1H010	PC electrolytic	1μF	50WV		
C6	CK94YG1E502Z	Ceramic	0.005μF	+80%	−20%	
C7	CE04W1C470	PC electrolytic	47μF	16WV		
C8	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%	
C9	CE04W1H010	PC electrolytic	1μF	50WV		
C10	CE04W1E100	PC electrolytic	10μF	25WV		
C11	CE04W1E4R7	PC electrolytic	4.7μF	25WV		
C12	CE04W1E3R3	PC electrolytic	3.3μF	25WV		
C13, 14	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C15	CC94SL1H220K	Ceramic	22pF	±10%		
C16	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	
C17, 18	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C19	CC94SL1H220K	Ceramic	22pF	±10%		
C20	CE04W1C330	PC electrolytic	33μF	16WV		
C21	CC94SL1H470K	Ceramic	47pF	±10%		
C22	CE04W1E3R3	PC electrolytic	3.3μF	25WV		
C23	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	

Circuit No.	Parts No.	Description				Remarks
C24	CK94YG1E403Z	Ceramic	0.04 μ F	+80%	-20%	
C25	CK94YG1E103Z	Ceramic	0.01 μ F	+80%	-20%	
C26	CC94SL1H271K	Ceramic	270pF	\pm 10%		
RESISTOR						
R1	PD14BY2E332J	Insulated carbon film	3.3k Ω	\pm 5%	1/4W	
R2	PD14BY2E473J	Insulated carbon film	47k Ω	\pm 5%	1/4W	
R3	PD14BY2E101J	Insulated carbon film	100 Ω	\pm 5%	1/4W	
R4	PD14BY2E222J	Insulated carbon film	2.2k Ω	\pm 5%	1/4W	
R5	PD14BY2E123J	Insulated carbon film	12k Ω	\pm 5%	1/4W	
R6	PD14BY2E102J	Insulated carbon film	1k Ω	\pm 5%	1/4W	
R7, 8	PD14BY2E223J	Insulated carbon film	22k Ω	\pm 5%	1/4W	
R9	PD14BY2E154J	Insulated carbon film	150k Ω	\pm 5%	1/4W	
R10	PD14BY2E221J	Insulated carbon film	220 Ω	\pm 5%	1/4W	
R11	PD14BY2E102J	Insulated carbon film	1k Ω	\pm 5%	1/4W	
R12	PD14BY2E821J	Insulated carbon film	820 Ω	\pm 5%	1/4W	
R13, 14	PD14BY2E221J	Insulated carbon film	220 Ω	\pm 5%	1/4W	
R15	PD14BY2E331J	Insulated carbon film	330 Ω	\pm 5%	1/4W	
R16	PD14BY2E104J	Insulated carbon film	100k Ω	\pm 5%	1/4W	
R17	PD14BY2E221J	Insulated carbon film	220 Ω	\pm 5%	1/4W	
R18	PD14BY2E102J	Insulated carbon film	1k Ω	\pm 5%	1/4W	
R19	PD14BY2E473J	Insulated carbon film	47k Ω	\pm 5%	1/4W	
R20	PD14BY2E222J	Insulated carbon film	2.2k Ω	\pm 5%	1/4W	
R21	PD14BY2E472J	Insulated carbon film	4.7k Ω	\pm 5%	1/4W	
POTENTIOMETER						
VR1	R12-4015-05	PC trimmer potentiometer	50k Ω	(B)		
VR2	R12-0030-05	PC trimmer potentiometer	100 Ω	(B)		
VR3	R12-1012-05	PC trimmer potentiometer	1k Ω	(B)		
SEMICONDUCTOR						
Q1		2SK24E				
Q2, 3		2SC733Y				
Q4		2SK19 (GR)				
D1 ~ 9		1N60				
MISCELLANEOUS						
L1, 2	L33-0104-05	Ferri-inductor				
L3	L33-0101-05	Ferri-inductor				
L4	L33-0089-05	Ferri-inductor				
T1	L30-0021-05	Balanced modulator coil (3.395 MHz)				
RL1	S51-1002-05	Reed relay				
TC1, 2	C05-0015-05	Ceramic trimmer				
—	J25-0466-04	PC board				

■ PC BOARD OF X50-0009-00

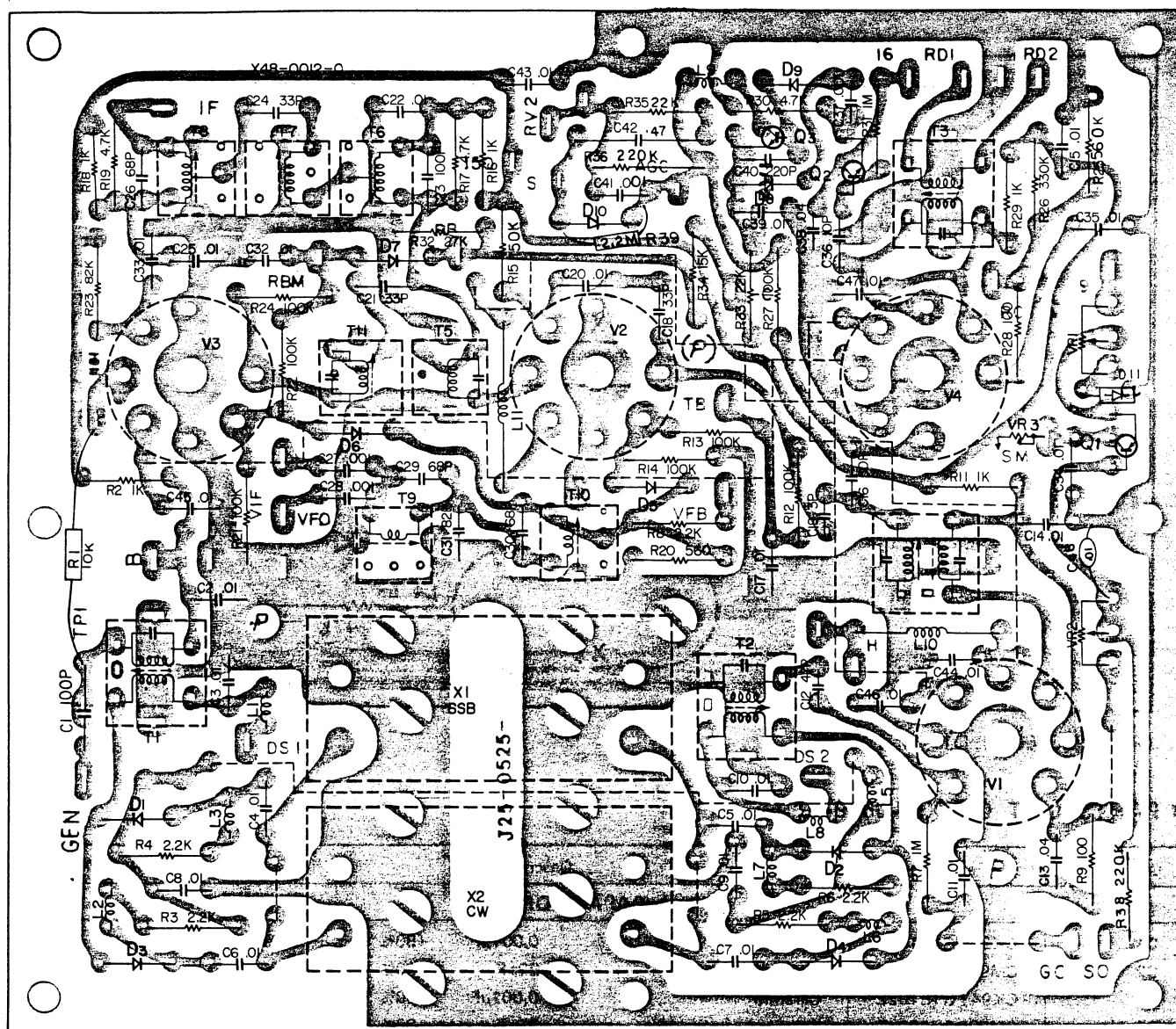


Q1, 2: 2SC460(B), D1 ~ 4: 1S1555

■ PARTS LIST OF X50-0009-00

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C2	CM93D2H220JZ	Mica	22pF	+80%	−20%	
C3	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C4	CM93D2H220JZ	Mica	22pF	+80%	−20%	
C5	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C6	CM93D2H220JZ	Mica	22pF	+80%	−20%	
C7	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C8	CK94YX1H471K	Ceramic	470pF	±10%		
C9	CC94TH1H221J	Ceramic	220pF	±5%		
C10	CC94SL1H101K	Ceramic	100pF	±10%		
C11	CM93D2H100JZ	Mica	10pF	+80%	−20%	
C12	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%	
C13	CM93D2H220JZ	Mica	22pF	+80%	−20%	
C14	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	
RESISTOR						
R1 ~ 4	PD14BY2E473J	Insulated carbon film	47kΩ	±5%	1/4W	
R5	PD14BY2E333J	Insulated carbon film	33kΩ	±5%	1/4W	
R6	PD14BY2E682J	Insulated carbon film	6.8kΩ	±5%	1/4W	
R7	PD14BY2E102J	Insulated carbon film	1kΩ	±5%	1/4W	
R8	PD14BY2E683J	Insulated carbon film	68kΩ	±5%	1/4W	
R9	PD14BY2E101J	Insulated carbon film	100Ω	±5%	1/4W	

■ PC BOARD OF X48-0012-00



Q1: 2SA562(Y), Q2: 2SC733(Y), Q3: 2SC373, V1, V4: 6BA6, V2, V3: 6CB6, D1 ~ D4, D7: 1N60, D5, D6: 1S73A, D8, D9: 0A90, D10: 1S1555

■ PARTS LIST OF X50-0009-00

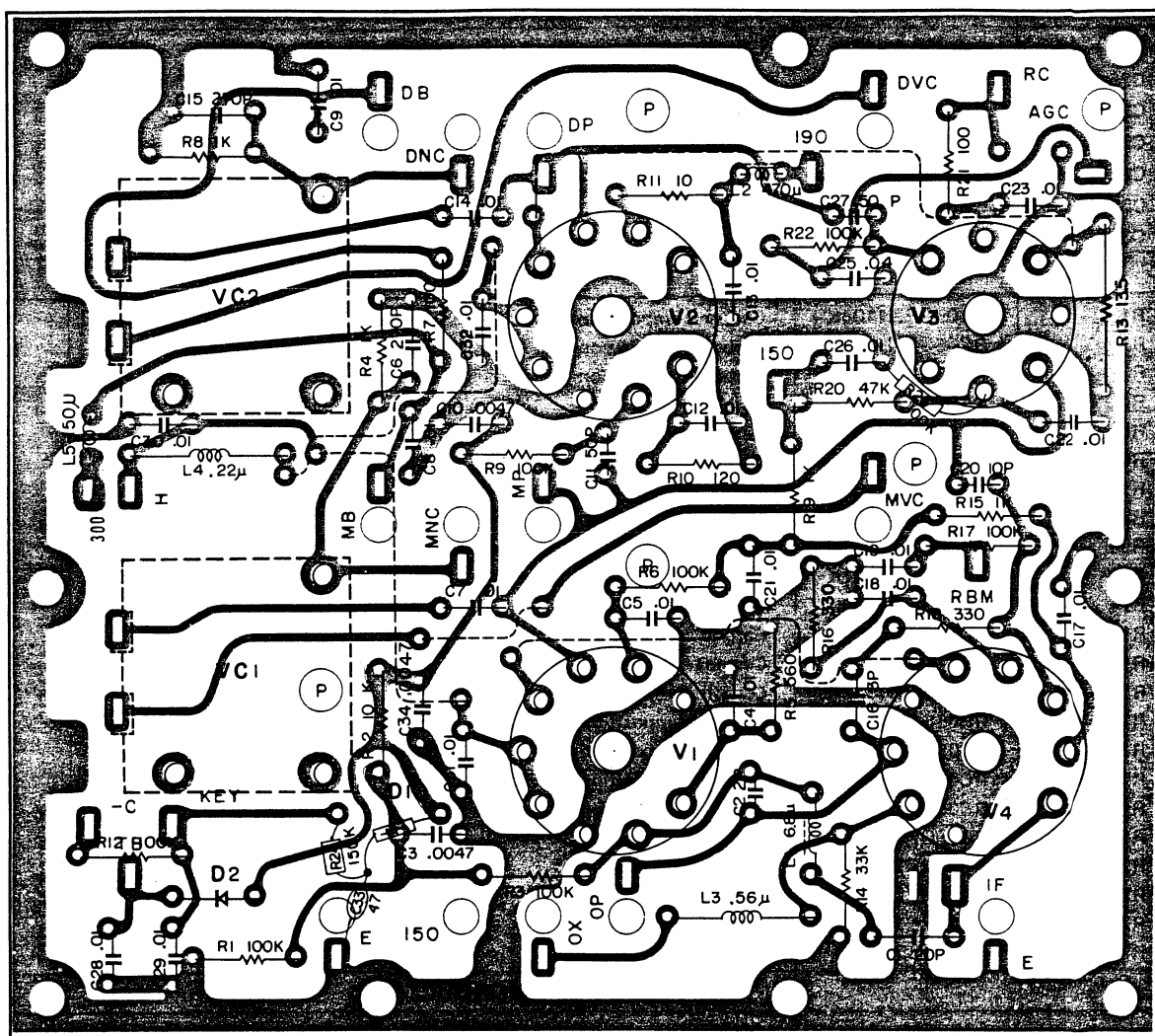
Circuit No.	Parts No.	Description	Remarks
SEMICONDUCTOR			
Q1, 2 D1 ~ 4		2SC460 (B) 1S1555	
MISCELLANEOUS			
L1 ~ 6	L33-0104-05	Ferri-inductor	
T1	L32-0003-05	Oscillator coil	
X1	L77-0123-05	Crystal oscillator (3395.0 kHz)	
X2	L77-0122-05	Crystal oscillator (3396.5 kHz)	
X3	L77-0120-05	Crystal oscillator (3393.5 kHz)	
TC1 ~ 3	C05-0013-05	Ceramic trimmer	
—	J25-0469-04	PC board	

■ PARTS LIST OF X48-0012-00

Circuits No.	Parts No.	Description			Remarks	
CAPACITOR						
C1	CC94SL2H101K	Ceramic	100pF	±10%		
C2 ~ 11	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C12	CC94SL2H470K	Ceramic	47pF	±10%		
C13	CK94YG1E403Z	Ceramic	0.04μF	+80%, -20%		
C14, 15	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C16	CC94SL2H470K	Ceramic	47pF	±10%		
C17	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C18	CC94SL2H330K	Ceramic	33pF	±10%		
C19	CC94SL2H030D	Ceramic	3pF	±0.5%		
C20	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C21	CC94SL2H330K	Ceramic	33pF	±10%		
C22	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C23	CM93D2H101J	Mica	100pF	±5%		
C24	CM93D2H330J	Mica	33pF	±5%		
C25	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C26	CM93D2H680J	Mica	68pF	±5%		
C27, 28	CK94YZ2H102P	Ceramic	0.001μF	+100%, -0%		
C29, 30	CM93D2H680J	Mica	68pF	±5%		
C31	CM93D2H820J	Mica	82pF	±5%		
C32 ~ 35	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C36	CC94SL2H100D	Ceramic	10pF	±0.5pF		
C37	CC94SL2H470K	Ceramic	47pF	±10%		
C38	CK94YG1E403Z	Ceramic	0.04μF	+80%, -20%		
C39	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C40	CC94SL2H221K	Ceramic	220pF	±10%		
C41	CK94YZ2H102P	Ceramic	0.01μF	+100%, -0%		
C42	CQ93M1H474K	Mylar	0.47μF	±10%		
C43	CK94YZ2H103Z	Ceramic	0.01μF	+100%, -0%		
C44	CK94YG1E403Z	Ceramic	0.04μF	+80%, -20%		
C45 ~ 48	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
RESISTOR						
R1	RC05GF2H103K	Carbon composition	10kΩ	±10%		1/2W
R2	RC05GF2H102K	Carbon composition	1kΩ	±10%		1/2W
R3 ~ 6	RC05GF2H222K	Carbon composition	2.2kΩ	±10%		1/2W
R7	RC05GF2H105K	Carbon composition	1MΩ	±10%		1/2W
R8	RC05GF2H222K	Carbon composition	2.2kΩ	±10%		1/2W
R9	RC05GF2H101K	Carbon composition	100Ω	±10%		1/2W
R11	RC05GF2H102K	Carbon composition	1kΩ	±10%		1/2W
R12 ~ 14	RC05GF2H104K	Carbon composition	100kΩ	±10%		1/2W
R15	RC05GF2H154K	Carbon composition	150kΩ	±10%		1/2W
R16	RC05GF2H102K	Carbon composition	1kΩ	±10%		1/2W
R17	RC05GF2H472K	Carbon composition	4.7kΩ	±10%		1/2W
R18	RC05GF2H102K	Carbon composition	1kΩ	±10%		1/2W
R19	RC05GF2H472K	Carbon composition	4.7kΩ	±10%		1/2W
R20	RC05GF2H561K	Carbon composition	560Ω	±10%		1/2W
R21, 22	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R23	RC05GF2H823K	Carbon composition	82kΩ	±10%	1/2W	
R24	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R25	RC05GF2H564K	Carbon composition	560kΩ	±10%	1/2W	

Circuit No.	Parts No.	Description	Remarks
R26	RC05GF2H274K	Carbon composition 270k Ω $\pm 10\%$ 1/2W	
R27	RC05GF2H104K	Carbon compotision 100k Ω $\pm 10\%$ 1/2W	
R28	RC05GF2H101K	Carbon composition 100 Ω $\pm 10\%$ 1/2W	
R29	RC05GF2H102K	Carbon composition 1k Ω $\pm 10\%$ 1/2W	
R30	RC05GF2H472K	Carbon composition 4.7k Ω $\pm 10\%$ 1/2W	
R31	RC05GF2H105K	Carbon composition 1M Ω $\pm 10\%$ 1/2W	
R32	RC05GF2H273K	Carbon composition 27k Ω $\pm 10\%$ 1/2W	
R33	RC05GF2H223K	Carbon composition 22k Ω $\pm 10\%$ 1/2W	
R34	RC05GF2H153K	Carbon composition 15k Ω $\pm 10\%$ 1/2W	
R35	RC05GF2H223K	Carbon composition 22k Ω $\pm 10\%$ 1/2W	
R36, 38	RC05GF2H224K	Carbon composition 220k Ω $\pm 10\%$ 1/2W	
R39	RC05GF2H225K	Carbon composition 2.2M Ω $\pm 10\%$ 1/2W	
TUBE/SEMICONDUCTOR			
V1		6BA6	
V2, 3		6CB6	
V4		6BA6	
Q1		2SA562 (Y)	
Q2		2SC733 (Y)	
Q3		2SC373	
D1 ~4		1N60	
D5, 6		1S73A	
D7		1N60	
D8, 9		0A90	
D10		1S1555	
D11		MV-13	
COIL/TRANS.			
L1 ~3	L33-0104-05	Ferri-inductor	
L5 ~9	L33-0104-05	Ferri-inductor	
L10	L33-0074-05	Heater choke	
L11	L33-0032-05	Heater choke	
T1, 2	L30-0070-05	IF trans. A (3.395MHz)	
T3	L30-0072-05	IF trans. C (3.395MHz)	
T4	L30-0203-05	IF trans. B (3.395MHz)	
T5	L31-0152-05	Trap coil (3.395MHz)	
T6	L30-0008-05	B.P.F. A (8MHz)	
T7	L30-0009-05	B.P.F. B (8MHz)	
T8	L30-0008-05	B.P.F. A (8MHz)	
T9, 10	L31-0185-05	Low pass coil (11MHz)	
T11	L31-0184-05	Trap coil (12.395MHz)	
MISCELLANEOUS			
—	E10-0701-05	Tube socket (7P) x 4	
—	F11-0088-05	Tube shield case (7P) x 4	
X1	L71-0004-05	Crystal filter	
VR1	R12-2014-05	PC trimmer potentiometer 5k Ω (B)	
VR2	R12-7009-05	PC trimmer potentiometer 500k Ω (B)	
VR3	R12-2014-05	PC trimmer potentiometer 5k Ω (B)	
—	J25-0525-13	PC board	

■ PC BOARD OF X47-0005-00



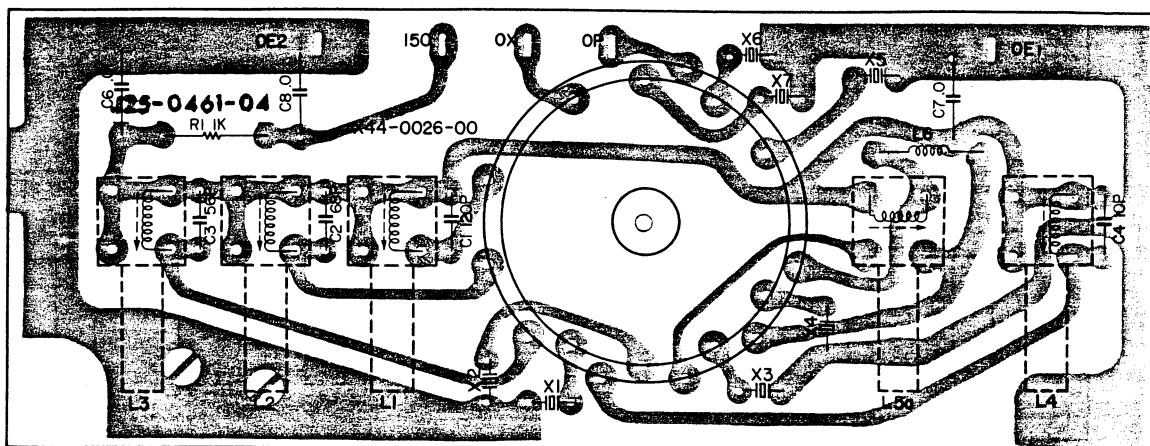
V1: 12GN7A, V2: 12BY7A, V3: 6BZ6, V4: 6AW8A, D1, D2: SM-150-01

■ PARTS LIST OF X47-0005-01

Circuit No.	Parts No.	Description			Remarks
CAPACITOR					
C1	CC45SL2H200J	Ceramic	20pF	±5%	
C2	CC94SL2H020C	Ceramic	2pF	±0.25pF	
C3	CK94YY2H472M	Ceramic	0.0047μF	±20%	
C4, 5	CK94YZ2H103P	Ceramic	0.01μF	+100%	—0%
C6	CM93D2H271J	Mica	270pF	±5%	
C7 ~ 9	CK94YZ2H103P	Ceramic	0.01μF	+100%	—0%
C10	CK94YY2H472M	Ceramic	0.0047μF	±20%	
C11	CC94SL2H500K	Ceramic	50pF	±10%	
C12 ~ 14	CK94YZ2H103P	Ceramic	0.01μF	+100%	—0%
C15	CM93D2H271J	Mica	270pF	±5%	
C16	CC94SL2H030C	Ceramic	3pF	±0.25pF	
C17 ~ 19	CK94YZ2H103P	Ceramic	0.01μF	+100%	—0%
C20	CC94SL2H100D	Ceramic	10pF	±0.5pF	

Circuit No.	Parts No.	Description				Remarks
C21 ~ 23	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C25	CK94YG1E403Z	Ceramic	0.04μF	+80%, -20%		
C26	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C27	CC94SL2H500K	Ceramic	50pF	±10%		
C28 ~ 32	CK94YZ2H103P	Ceramic	0.01μF	+100%, -0%		
C33	CQ93M2A473K	Mylar	0.047μF	±10%		
C34	CK45D2H472M	Ceramic	0.0047μF	±20%		
RESISTOR						
R1	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R2	RC05GF2H103K	Carbon composition	10kΩ	±10%	1/2W	
R3	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R4	RC05GF2H102K	Carbon composition	1kΩ	±10%	1/2W	
R5	RC05GF2H561K	Carbon composition	560Ω	±10%	1/2W	
R6	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R7	RC05GF2H101K	Carbon composition	100Ω	±10%	1/2W	
R8	RC05GF2H102K	Carbon composition	1kΩ	±10%	1/2W	
R9	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R10	RC05GF2H121K	Carbon composition	120Ω	±10%	1/2W	
R11	RC05GF2H100K	Carbon composition	10Ω	±10%	1/2W	
R12	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R13	R92-0068-05	Cement coated	13.5Ω	±10%		
R14	RC05GF2H333K	Carbon composition	33kΩ	±10%	1/2W	
R15	RC05GF2H102K	Carbon composition	1kΩ	±10%	1/2W	
R16	RC05GF2H331K	Carbon composition	330Ω	±10%	1/2W	
R17	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R18	RC05GF2H331K	Carbon composition	330Ω	±10%	1/2W	
R19	RC05GF2H102K	Carbon composition	1kΩ	±10%	1/2W	
R20	RC05GF2H473K	Carbon composition	47kΩ	±10%	1/2W	
R21	RC05GF2H101K	Carbon composition	100Ω	±10%	1/2W	
R22, 23	RC05GF2H104K	Carbon composition	100kΩ	±10%	1/2W	
R24	PD14BY2H154J	Insulated carbon film	150kΩ	±5%	1/4W	
TUBE/SEMICONDUCTOR						
V1		12GN7A				
V2		12BY7A				
V3		6BZ6				
V4		6AW8A				
D1, 2		SM-150-01				
COIL						
L1	L33-0144-05	Ferri-inductor				
L2	L33-0101-05	Ferri-inductor				
L3	L32-0128-05	Oscillator coil	(0.56μH)			
L4	L33-0074-05	Heater choke	(0.22μH)			
L5	L33-0098-05	Ferri-inductor				
MISCELLANEOUS						
VC1, 2	C01-0127-09	Variable capacitor				
—	D13-0032-03	Sprocket				
—	E10-0701-05	Tube socket (7P)				
—	E10-1901-05	Tube socket (9P)				
—	E10-1902-05	Tube socket (9P) x 2				
—	F11-0020-05	Shield case (9P) x 2				
—	F11-0088-05	Shield case (7P)				
—	J25-0460-13	PC board				

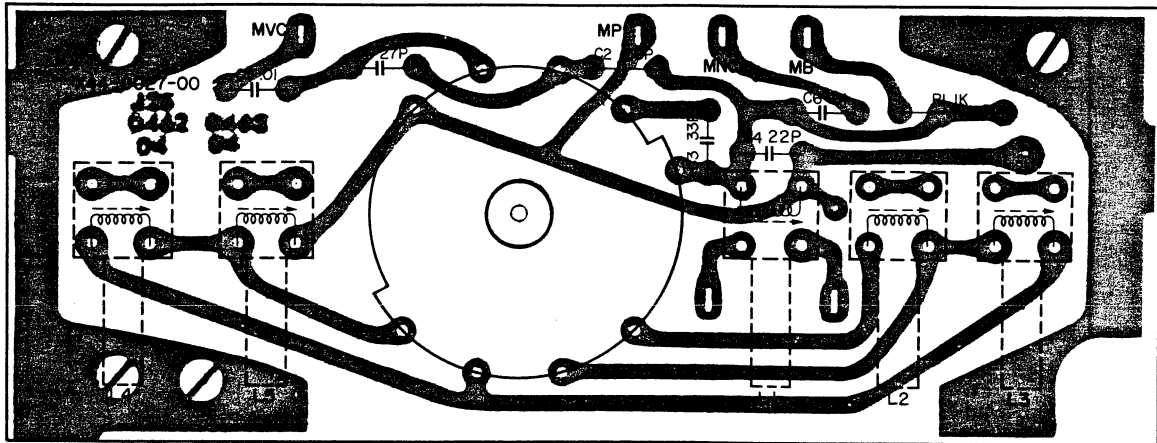
■ PC BOARD OF X44-0026-00



■ PARTS LIST OF X44-0026-00

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CM93D2H121J	Mica	120pF	±5%		
C2	CM93D2H680J	Mica	68pF	±5%		
C3	CM93D2H560J	Mica	56pF	±5%		
C4	CM93D2H100J	Mica	10pF	±5%		
C6 ~ 8	CK94YZ2H103P	Ceramic	0.01μF	+100% -0%		
C9	CM93D2H330J	Mica	33pF	±5%		
RESISTOR/COIL						
R1	RC05GF2H102K	Carbon composition				
L1, 2	L31-0032-04	Oscillator coil				
L3	L31-0033-04	Oscillator coil				
L4	L32-0011-04	Oscillator coil				
L5a, 5b	L32-0138-05	Oscillator coil				
L6	L32-0012-04	Oscillator coil				
MISCELLANEOUS						
X1	L77-0141-05	Crystal oscillator (12.395 MHz)				
X2	L77-0142-05	Crystal oscillator (15.895 MHz)				
X3	L77-0143-05	Crystal oscillator (22.895 MHz)				
X4	L77-0144-05	Crystal oscillator (29.895 MHz)				
X5	L77-0145-05	Crystal oscillator (36.895 MHz)				
X6	L77-0146-05	Crystal oscillator (37.395 MHz)				
X7	L77-0147-05	Crystal oscillator (37.995 MHz)				
S01, 2	S29-1005-05	Rotary wafer				
—	J25-0461-04	PC board				

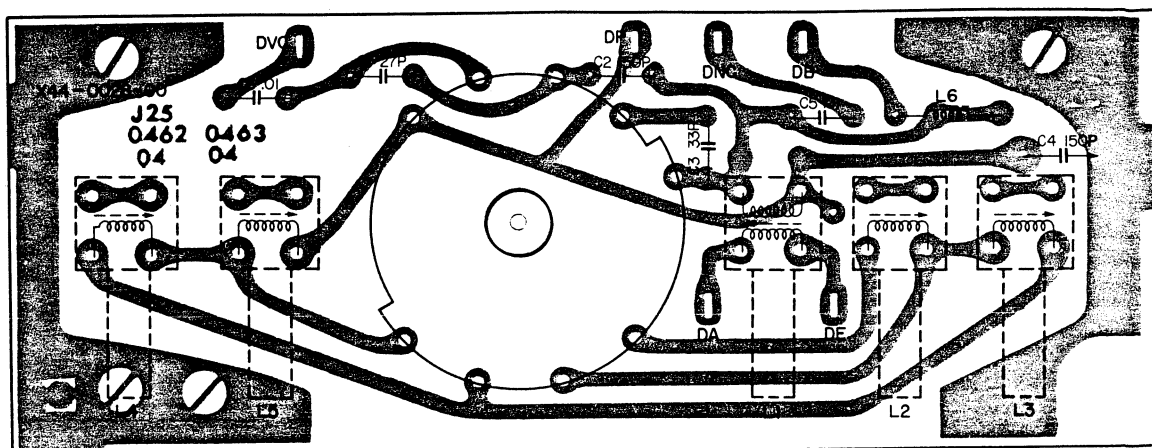
■ PC BOARD OF X44-0027-00



■ PARTS LIST OF X44-0027-00

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CM93D2H270J	Mica	27pF	±5%		
C2	CM93D2H151J	Mica	150pF	±5%		
C3	CM93D2H330J	Mica	33pF	±5%		
C4	CM93D2H220J	Mica	22pF	±5%		
C5, 6	CK94Y Z2H103P	Ceramic	0.01μF	+100%	−0%	
RESISTOR/COIL						
R1	RC05GF2H102K	Carbon composition	1kΩ	±10%	1/2W	
L1	L31-0036-04	Tuning coil (3.5 MHz)				
L2	L31-0032-04	Tuning coil (7 MHz)				
L3	L31-0033-04	Tuning coil (14 MHz)				
L4	L31-0034-04	Tuning coil (21 MHz)				
L5	L31-0187-05	Tuning coil (28 MHz)				
SM1, 2	S29-1052-05	Rotary wafer				
—	J25-0462-04	PC board				

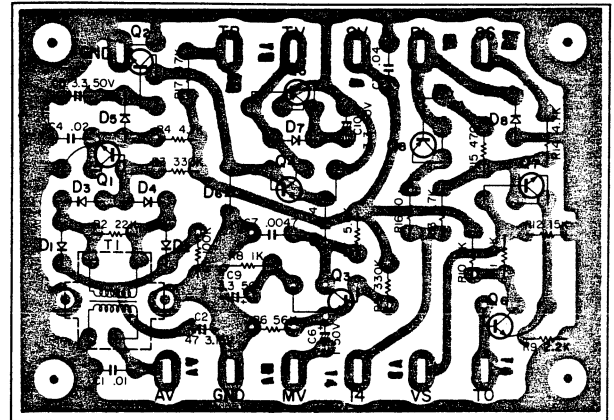
■ PC BOARD OF X44-0028-00



■ PARTS LIST OF X44-0028-00

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CM93D2H270J	Mica	27pF	±5%		
C2	CM93D2H151J	Mica	150pF	±5%		
C3	CM93D2H330J	Mica	33pF	±5%		
C4	CM91D3A151KY	Mica	150pF	±10%		
C5, 6	CK94YZ2H103P	Ceramic	0.01μF	+100%	−0%	
COIL						
L1	L31-0031-04	Tuning coil (3.5 MHz)				
L2	L31-0032-04	Tuning coil (7 MHz)				
L3	L31-0033-04	Tuning coil (14 MHz)				
L4	L31-0034-04	Tuning coil (21 MHz)				
L5	L31-0187-05	Tuning coil (28 MHz)				
L6	L33-0096-05	Ferri-inductor				
MISCELLANEOUS						
SD12	S29-1052-05	Rotary wafer				
—	J25-0463-04	PC board				

■ PC BOARD OF X54-0001-01



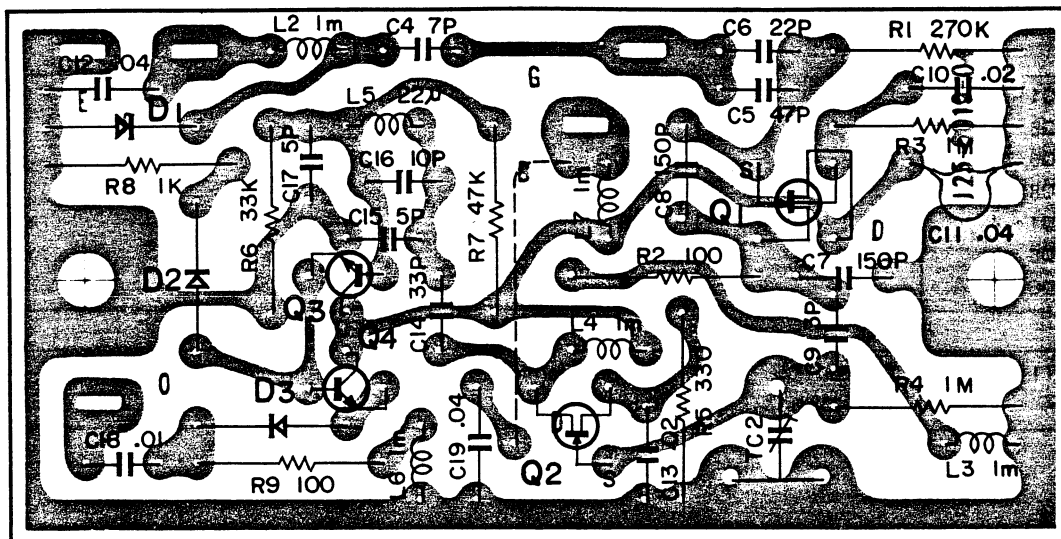
Q1 ~ 4, 6, 7: 2SC373, Q5, 8: 2SA562(Y),
D1 ~ 4; 6 ~ 8: 1N60, D5: S-1.5-01

■ PARTS LIST OF X54-0001-01

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	
C2	CE04W0F470	PC electrolytic	47μF	3.15WV		
C3	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%	
C4	CK94YG1E203Z	Ceramic	0.02μF	+80%	−20%	
C5	CE04W1H3R3	PC electrolytic	3.3μF	50WV		
C6	CE04W1H010	PC electrolytic	1μF	50WV		
C7	CK94YY1H472M	Ceramic	0.0047μF	±20%		
C8	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%	
C9, 10	CE04W1H3R3	PC electrolytic	3.3μF	50WV		
RESISTOR						
R1	PD14CY2E104J	Insulated carbon film	100kΩ	±5%	1/4W	
R2	PD14CY2E223J	Insulated carbon film	22kΩ	±5%	1/4W	
R3	PD14CY2E334J	Insulated carbon film	330kΩ	±5%	1/4W	
R4	PD14CY2E472J	Insulated carbon film	4.7kΩ	±5%	1/4W	
R5	PD14CY2E334J	Insulated carbon film	330kΩ	±5%	1/4W	
R6	PD14CY2E563J	Insulated carbon film	56kΩ	±5%	1/4W	
R7	PD14CY2E562J	Insulated carbon film	5.6kΩ	±5%	1/4W	
R8	PD14CY2E102J	Insulated carbon film	1kΩ	±5%	1/4W	
R9	PD14CY2E222J	Insulated carbon film	2.2kΩ	±5%	1/4W	
R10	PD14CY2E102J	Insulated carbon film	1kΩ	±5%	1/4W	
R11	PD14CY2D103J	Insulated carbon film	10kΩ	±5%	1/4W	
R12	PD14CY2E153J	Insulated carbon film	15kΩ	±5%	1/4W	
R13, 14	PD14CY2E472J	Insulated carbon film	4.7kΩ	±5%	1/4W	
R15	PD14CY2E471J	Insulated carbon film	470Ω	±5%	1/4W	
R16	PD14CY2E100J	Insulated carbon film	10Ω	±5%	1/4W	
R17	PD14CY2E473J	Insulated carbon film	47kΩ	±5%	1/4W	

Circuit No.	Parts No.	Description	Remarks
SEMICONDUCTOR			
Q1~4 Q5 Q6, 7 Q8 D1 ~4 D5 D6 ~8		2SC373 2SA562Y 2SC373 2SA562Y 1N60 S-1.5-01 1N60	
MISCELLANEOUS			
T1 —	L13-0001-05 J25-0037-04	Input transformer PC board	

■ PC BOARD OF X40-0016-02



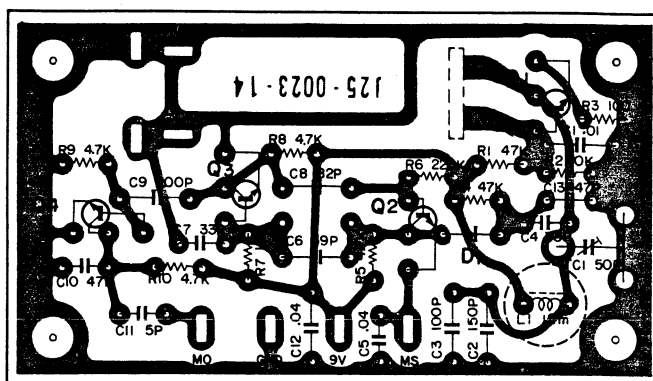
Q1: 3SK22(Y), Q2: 2SK19(Y), Q3, 4: 2SC460(B), D1: SD111, D2, 3: 1N60

■ PARTS LIST OF X40-0016-02

Circuit No.	Parts No.	Description	Remarks
CAPACITOR			
C1	CC94PG1H470J	Ceramic 47pF ±5%	
C2, 3	CC94LG1H150J	Ceramic 15pF ±5%	
C3	CC94CG1H150J	Ceramic 15pF ±5%	
C3	CC94PG1H150J	Ceramic 15pF ±5%	
C4	CC94SG1H070J	Ceramic 7pF ±5%	

Circuit No.	Parts No.	Description				Remarks
C5	CC94LG1H470J	Ceramic	47pF	±5%		
C6	CC94LG1H220J	Ceramic	22pF	±5%		
C7, 8	CM93D2A151J	Mica	150pF	±5%		
C9	CM93D1H030J	Mica	3pF	±0.5%		
C10	CK94YG1E203Z	Ceramic	0.02μF	+80%	−20%	
C11, 12	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%	
C13	CK94YG1E203Z	Ceramic	0.02μF	+80%	−20%	
C14	CC94SL1H330D	Ceramic	33pF	±0.5%		
C15	CC94SL1H050D	Ceramic	5pF	±0.5pF		
C16	CC94SL1H100D	Ceramic	10pF	±0.5pF		
C17	CC94SL1H050D	Ceramic	5pF	±0.5pF		
C18	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	
C19	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%	
C20	CC94CG1H100J	Ceramic	10pF	±5%		
RESISTOR						
R1	PD14BY2E274J	Insulated carbon film	270kΩ	±5%	1/4W	
R2	PD14BY2E101J	Insulated carbon film	100Ω	±5%	1/4W	
R3, 4	PD14BY2E105J	Insulated carbon film	1MΩ	±5%	1/4W	
R5	PD14BY2E331J	Insulated carbon film	330Ω	±5%	1/4W	
R6	PD14BY2E333J	Insulated carbon film	33kΩ	±5%	1/4W	
R7	PD14BY2E473J	Insulated carbon film	47kΩ	±5%	1/4W	
R8	PD14BY2E102J	insulated carbon film	1kΩ	±5%	1/4W	
R9	PD14BY2E101J	Insulated carbon film	100Ω	±5%	1/4W	
SEMICONDUCTOR						
Q1		3SK22 (Y)				
Q2		2SK19 (Y)				
Q3, 4		2SC460 (B)				
D1		SD111				
D2, 3		1N60				
MISCELLANEOUS						
—	F11-0004-23	VFO box (A)				
—	F11-0005-04	VFO box (B)				
—	F11-0121-14	VFO box (C)				
—	F11-0007-14	VFO box (D)				
—	F11-0008-04	VFO box (E)				
—	F11-0122-04	VFO box (F)				
—	F11-0010-04	VFO box (G)				
—	F11-0011-04	VFO box (H)				
—	F11-0012-04	VFO box (I)				
L2 ~ 4	L33-0104-05	Ferri-inductor				
L5	L33-0091-05	Ferri-inductor				
L6, 7	L33-0104-05	Ferri-inductor				
—	L32-0098-05	Oscillator coil				
—	B42-0010-04	Name plate				
—	C01-0001-05	Variable capacitor				
—	C03-0001-05	Variable capacitor				
—	D22-0011-05	Shaft coupling				
—	D40-0099-15	Dial mechanism				
—	J25-0019-04	PC board				
TC2	C05-0013-05	Ceramic trimmer				

■ PC BOARD OF X52-0005-01

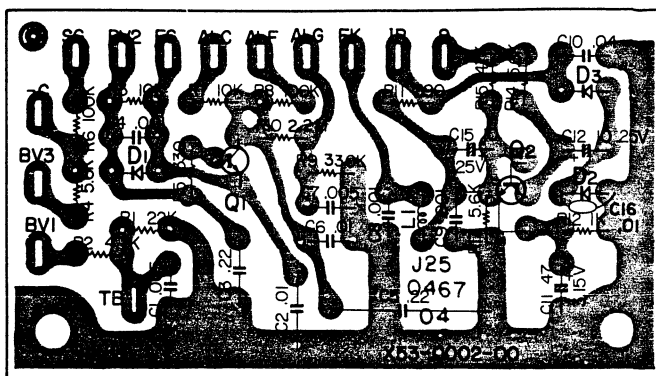


Q1, 4: 2SC373 or 2SC458(B), Q2, 3: 2SC373, D1: 1N60

■ PARTS LIST OF X52-0005-01

Circuit No.	Parts No.	Description	Remarks
CAPACITOR			
C1	CK94YY2H103M	Ceramic	0.01μF ±20%
C2	CM93D2H151J	Mica	150pF ±5%
C3	CC94TH2H101J	Ceramic	100pF ±5%
C4	CM93D2H330J	Mica	33pF ±5%
C5	CK94YG1E403Z	Ceramic	0.04μF +80% -20%
C6	CM93D2H390J	Mica	39pF ±5%
C7	CM93D2H330J	Mica	33pF ±5%
C8	CM93D2H820J	Mica	82pF ±5%
C9	CM93D2H201J	Mica	200pF ±5%
C10	CC94SL1H470K	Ceramic	47pF ±10%
C11	CC94SL2H050D	Ceramic	5pF ±0.5pF
C12	CK94YG1E403Z	Ceramic	0.04μF +80% -20%
C13	CM93D2H470J	Mica	47pF ±5%
RESISTOR			
R1	PD14CY2E473J	Insulated carbon film	47kΩ ±5% 1/4W
R2	PD14CY2E103J	Insulated carbon film	10kΩ ±5% 1/4W
R3	PD14CY2E101J	Insulated carbon film	100Ω ±5% 1/4W
R4	PD14CY2E473J	Insulated carbon film	47kΩ ±5% 1/4W
R5	PD14CY2E472J	Insulated carbon film	4.7kΩ ±5% 1/4W
R6	PD14CY2E224J	Insulated carbon film	220kΩ ±5% 1/4W
R7	RC05GF2H105J	Carbon composition	1MΩ ±5% 1/2W
R8 ~ 10	PD14CY2E472J	Insulated carbon film	4.7kΩ ±5% 1/4W
SEMICONDUCTOR			
Q1		2SC373 or 2SC458 (B)	
Q2,3		2SC373	
Q4		2SC373 or 2SC458 (B)	
D1		1N60	
L1	L33-0118-05	Ferri-inductor	
—	J19-0013-04	Crystal oscillator socket	
X1	L77-0009-05	Crystal oscillator	
—	J25-0023-14	PC board (A)	
—	J25-0024-04	PC board (B)	
—	C05-0029-05	Ceramic trimmer	

■ PC BOARD OF X53-0002-00

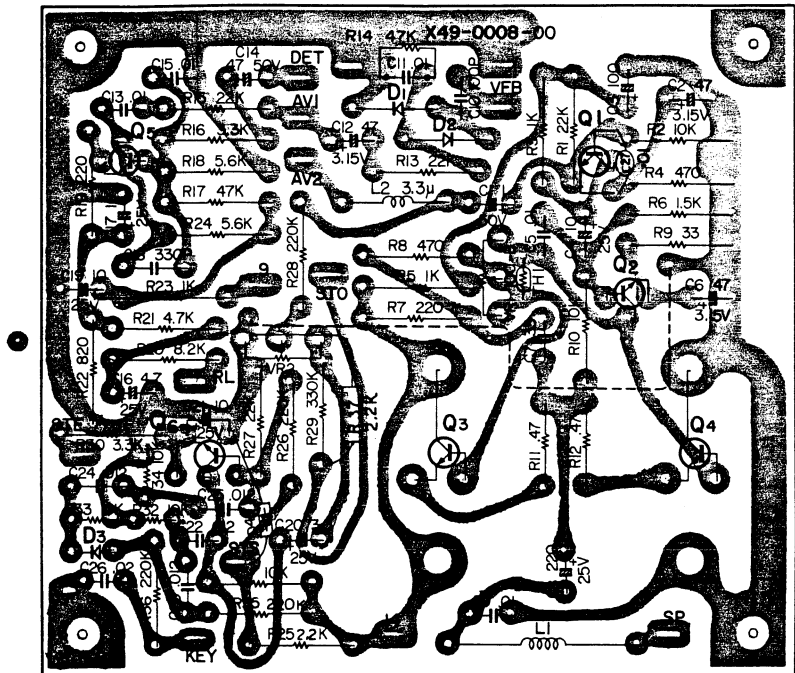


Q1: 2SC856, Q2: 2SC458, D1 ~ 3: 1N60

■ PARTS LIST OF X53-0002-00

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CK94YG1E502Z	Ceramic	0.005μF	+80%	−20%	
C2	CK94YZ2H103P	Ceramic	0.01μF	+100%	−0%	
C3	CH02S2C224M	Metalized paper	0.22μF	±20%		
C4	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C5	CQ93M1H224J	Mylar	0.22μF	±5%		
C6	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	
C7	CK94YG1E502Z	Ceramic	0.005μF	+80%	−20%	
C8, 9	CK94YG1E102Z	Ceramic	0.001μF	+80%	−20%	
C10	CK94YG1E403Z	Ceramic	0.04μF	+80%	−20%	
C11	CE04W0F470	PC electrolytic	47μF	3.15WV		
C12, 15	CE04W1E100	PC electrolytic	10μF	25WV		
C16	CK94YG1E103Z	Ceramic	0.01μF	+80%	−20%	
RESISTOR						
R1	PD14CY2E223J	Insulated carbon film	22kΩ	±5%	1/4W	
R2	PD14CY2E682J	Insulated carbon film	6.8kΩ	±5%	1/4W	
R3	PD14CY2E103J	Insulated carbon film	10kΩ	±5%	1/4W	
R4	PD14CY2E392J	Insulated carbon film	3.9kΩ	±5%	1/4W	
R5	PD14CY2E331J	Insulated carbon film	330Ω	±5%	1/4W	
R6	PD14CY2E104J	Insulated carbon film	100kΩ	±5%	1/4W	
R7	PD14CY2E103J	Insulated carbon film	10kΩ	±5%	1/4W	
R8	PD14CY2E104J	Insulated carbon film	100kΩ	±5%	1/4W	
R9	PD14CY2E334J	Insulated carbon film	330kΩ	±5%	1/4W	
R10	RC05GF2H225K	Insulated carbon film	2.2MΩ	±10%	1/2W	
R11	PD14CY2E391J	Insulated carbon film	390Ω	±5%	1/4W	
R12	PD14CY2E102J	Insulated carbon film	1kΩ	±5%	1/4W	
R13, 14	PD14CY2E562J	Insulated carbon film	5.6kΩ	±5%	1/4W	
R15	PD14CY2E473J	Insulated carbon film	47kΩ	±5%	1/4W	
SEMICONDUCTOR						
Q1		2SC856				
Q2		2SC458				
D1 ~ 3		1N60				
MISCELLANEOUS						
L1	L33-0099-05	Ferri-inductor				
—	J25-0467-04	PC board				

■ PC BOARD OF X49-0008-00



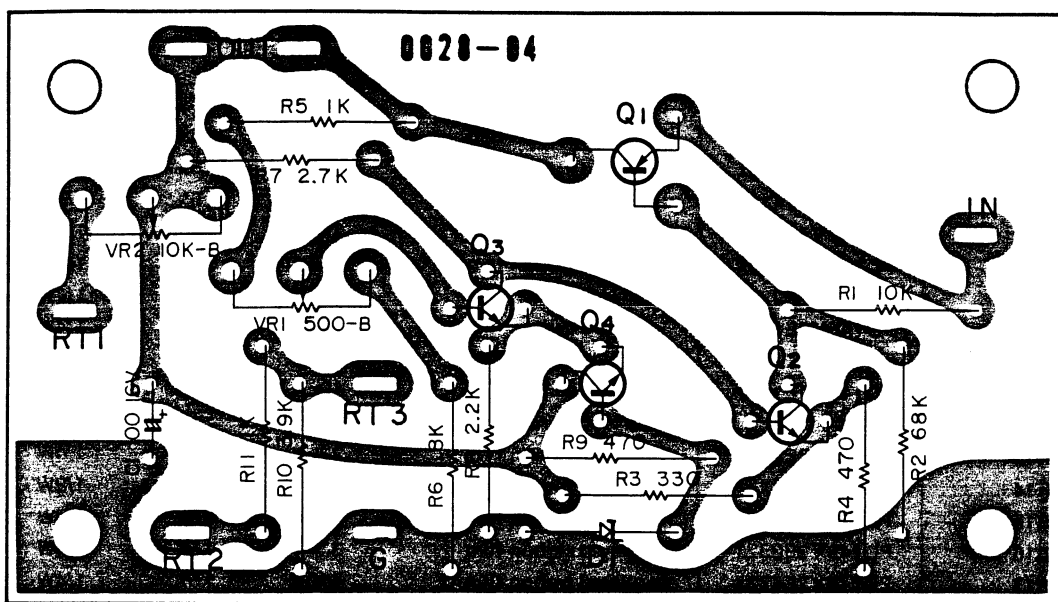
Q1: 2SC733(Y), Q2: 2SC734(Y), Q3: 2SD90, Q4: 2SB473,
Q5: 2SC458(B), Q6: 2SC733(Y), D1 ~ 3: 1N60, TH1: 5T-31
D4: RD13A

■ PARTS LIST OF X49-0008-00

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CE04W1H010	PC electrolytic	1 μ F	50WV		
C2	CE04W0F470	PC electrolytic	47 μ F	3.15WV		
C3	CE04W1C101	PC electrolytic	100 μ F	16WV		
C4	CE04W1E100	PC electrolytic	10 μ F	25WV		
C5	CK94YY1H103M	Ceramic	0.01 μ F	\pm 20%		
C6	CE04W0F470	PC electrolytic	47 μ F	3.15WV		
C7	CE04W1C330	PC electrolytic	33 μ F	16WV		
C8	CE04W1E221	PC electrolytic	220 μ F	25WV		
C9	CK94YG1E103Z	Ceramic	0.01 μ F	+80%	-20%	
C10	CC94SL1H101K	Ceramic	100pF	\pm 10%		
C11	CK94YG1E103Z	Ceramic	0.01 μ F	+80%	-20%	
C12	CE04W0F470	PC electrolytic	47 μ F	3.15WV		
C13	CK94YG1E103Z	Ceramic	0.01 μ F	+80%	-20%	
C14	CE04W1HR47	PC electrolytic	0.47 μ F	50WV		
C15	CK94YG1E103Z	Ceramic	0.01 μ F	+80%	-20%	
C16	CE04W1E4R7	PC electrolytic	4.7 μ F	25WV		
C17	CE04W1E100	PC electrolytic	10 μ F	25WV		
C18	CM93D1H331J	Mica	330pF	\pm 5%		
C19	CE04W1E100	PC electrolytic	10 μ F	25WV		
C20	CE04W1E3R3	PC electrolytic	3.3 μ F	25WV		
C21	CE04W1E100	PC electrolytic	10 μ F	25WV		
C22 ~ 25	CQ93M1H123K	Mylar	0.012 μ F	\pm 10%		
C26	CK94YG1E203Z	Ceramic	0.02 μ F	+80%	-20%	
C27	CK94YG1E103Z	Ceramic	0.01 μ F	+80%	-20%	

Circuit No.	Parts No.	Description	Remarks
CAPACITOR			
R1	PD14BY2E223J	Insulated carbon film 22k Ω \pm 5% 1/4W	
R2	PD14BY2E103J	Insulated carbon film 10k Ω \pm 5% 1/4W	
R3	PD14BY2E102J	Insulated carbon film 1k Ω \pm 5% 1/4W	
R4	PD14BY2E471J	Insulated carbon film 470 Ω \pm 5% 1/4W	
R5	PD14BY2E102J	Insulated carbon film 1k Ω \pm 5% 1/4W	
R6	PD14BY2E152J	Insulated carbon film 1.5k Ω \pm 5% 1/4W	
R7	PD14BY2E221J	Insulated carbon film 220 Ω \pm 5% 1/4W	
R8	PD14BY2E471J	Insulated carbon film 470 Ω \pm 5% 1/4W	
R9	PD14BY2E330J	Insulated carbon film 33 Ω \pm 5% 1/4W	
R10	PD14BY2E103J	Insulated carbon film 10k Ω \pm 5% 1/4W	
R11, 12	R92-0041-15	Wire wound resin coated 0.47 Ω \pm 10% 1W	
R13	PD14BY2E223J	Insulated carbon film 22k Ω \pm 5% 1/4W	
R14	PD14BY2B473J	Insulated carbon film 47k Ω \pm 5% 1/8W	
R15	PD14BY2E223J	Insulated carbon film 22k Ω \pm 5% 1/4W	
R16	PD14BY2E332J	Insulated carbon film 3.3k Ω \pm 5% 1/4W	
R17	PD14BY2E473J	Insulated carbon film 47k Ω \pm 5% 1/4W	
R18	PD14BY2E562J	Insulated carbon film 5.6k Ω \pm 5% 1/4W	
R19	PD14BY2E221J	Insulated carbon film 220 Ω \pm 5% 1/4W	
R20	PD14BY2E822J	Insulated carbon film 8.2k Ω \pm 5% 1/4W	
R21	PD14BY2E472J	Insulated carbon film 4.7k Ω \pm 5% 1/4W	
R22	PD14BY2E821J	Insulated carbon film 820 Ω \pm 5% 1/4W	
R23	PD14BY2E102J	Insulated carbon film 1k Ω \pm 5% 1/4W	
R24	PD14BY2E562J	Insulated carbon film 5.6k Ω \pm 5% 1/4W	
R25	PD14BY2E222J	Insulated carbon film 2.2k Ω \pm 5% 1/4W	
R26	PD14BY2E104J	Insulated carbon film 100k Ω \pm 5% 1/4W	
R27	PD14BY2E223J	Insulated carbon film 22k Ω \pm 5% 1/4W	
R28	PD14BY2E224J	Insulated carbon film 220k Ω \pm 5% 1/4W	
R29	PD14BY2E104J	Insulated carbon film 100k Ω \pm 5% 1/4W	
R30	PD14BY2E332J	Insulated carbon film 3.3k Ω \pm 5% 1/4W	
R31	PD14BY2E103J	Insulated carbon film 10k Ω \pm 5% 1/4W	
R32 ~ 34	PD14CY2E103J	Insulated carbon film 10k Ω \pm 5% 1/4W	
R35, 36	PD14BY2E224J	Insulated carbon film 220k Ω \pm 5% 1/4W	
R37	PD14BY2E222J	Insulated carbon film 2.2k Ω \pm 5% 1/4W	
SEMICONDUCTOR			
Q1		2SC733 (Y)	
Q2		2SC734 (Y)	
Q3		2SD90 (O)	
Q4		2SB473 (C.D.N)	
Q5		2SC458 (B)	
Q6		2SC733 (Y)	
D1 ~ 3		1N60	
D4		RD13A	
TH1		5T-31	
MISCELLANEOUS			
—	F01-0074-24	Heat sink	
L1	L33-0032-05	Heater choke	
L2	L33-0088-05	Ferri-inductor	
—	J25-0465-04	PC board	
VR1	R12-0030-05	PC trimmer potentiometer 100 Ω (B)	
VR2	R12-4015-05	PC trimmer potentiometer 50k Ω (B)	

■ PC BOARD OF X43-0010-01



Q1: 2SA606(L), Q2 ~ 4: 2SC372, D1: RD6AM

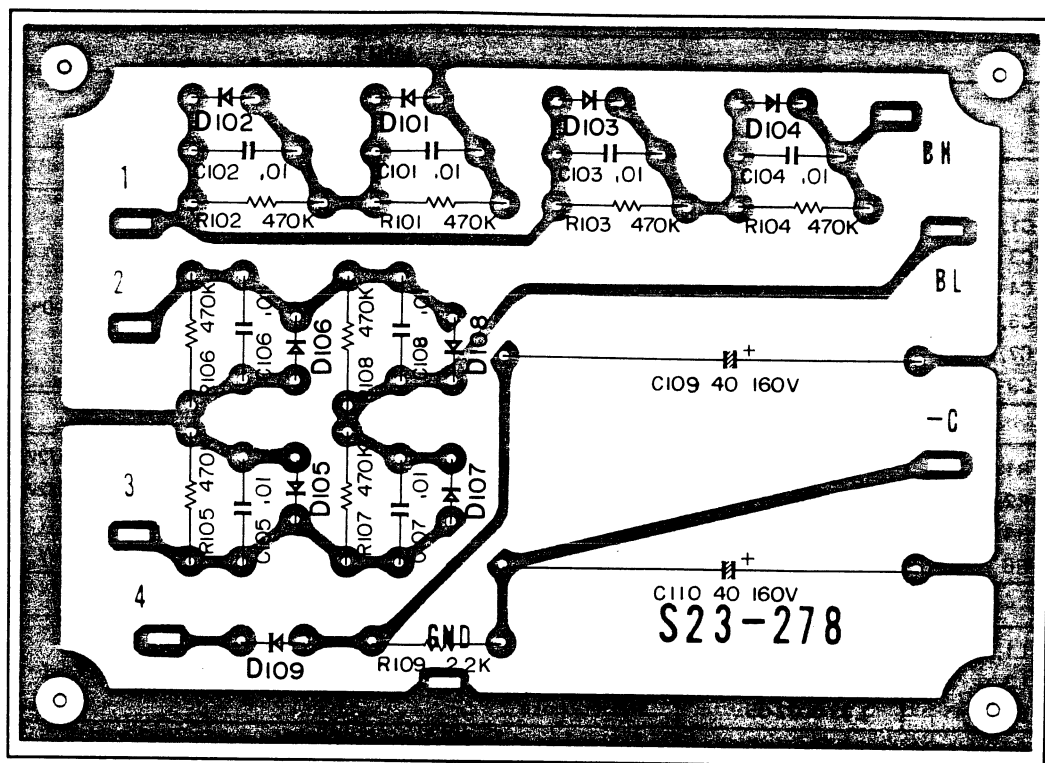
■ PARTS LIST OF X43-0010-01

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CE04W1C101	PC electrolytic	100μF	16WV		
RESISTOR						
R1	PD14BY2E103J	Insulated carbon film	10kΩ	±5%	1/4W	
R2	PD14BY2E683J	Insulated carbon film	68kΩ	±5%	1/4W	
R3	PD14BY2E331J	Insulated carbon film	330Ω	±5%	1/4W	
R4	PD14BY2E471J	Insulated carbon film	470Ω	±5%	1/4W	
R5	PD14BY2E102J	Insulated carbon film	1kΩ	±5%	1/4W	
R6	PD14BY2E182J	Insulated carbon film	1.8kΩ	±5%	1/4W	
R7	PD14BY2E272J	Insulated carbon film	2.7kΩ	±5%	1/4W	
R8	PD14BY2E222J	Insulated carbon film	2.2kΩ	±5%	1/4W	
R9	PD14BY2E471J	Insulated carbon film	470Ω	±5%	1/4W	
R10	PD14BY2E392J	Insulated carbon film	3.9kΩ	±5%	1/4W	
R11	PD14BY2E102J	Insulated carbon film	1kΩ	±5%	1/4W	
SEMICONDUCTOR						
Q1		2SA606 (L)				
Q2 ~ 4		2SC372				
D1		RD6AM				
MISCELLANEOUS						
VR1	R12-0023-05	PC trimmer potentiometer	500Ω	(B)		
VR2	R12-3022-05	PC trimmer potentiometer	10kΩ	(B)		
—	J25-0028-04	PC board				

■ PARTS LIST OF PS-515 (Y56-0011-07)

Circuit No.	Parts No.	Description	Remarks
UNIT			
—	X43-0004-01	Constant voltage unit	
—	X43-0005-00	Rectifier unit	
CAPACITOR			
C1, 2	CK94YY3A103M	Ceramic 0.01 μ F \pm 20%	
C3	CP02B2J474M	Oil filled 0.47 μ F \pm 20%	
C4	CE62AD2V400X4	Electrolytic block 40 μ F 350WV	
C5, 6	CK94YZ2H103P	Ceramic 0.01 μ F +100% —0%	
C7, 8	CE62AD2H101	Electrolytic block 100 μ F 500WV	
C9	CE62AD2V400X4	Electrolytic block 40 μ F 350WV	
RESISTOR			
R1	RC05GF2H154K	Carbon composition 150k Ω \pm 10% 1/2W	
R2, 3	RC05GF2H474K	Carbon composition 470k Ω \pm 10% 1/2W	
R4	RN14AB3T222J	Metal film 2.2k Ω \pm 5% 7W	
R6	RN14AB3T182J	Metal film 1.8k Ω \pm 5% 7W	
COIL			
L1, 2	L33-0029-05	Line filter	
L3	L15-0008-05	Choke coil	
L4, 5	L33-0032-05	Heater choke	
MISCELLANEOUS			
—	A01-0133-03	Case	
—	A20-0494-03	Panel assembly	
—	A40-0072-12	Bottom plate	
—	B01-0034-04	Side escutcheon (A)	
—	B01-0035-04	Side escutcheon (B)	
N1	B30-0044-05	Pilot lamp holder	
—	B42-0009-04	Passed sticker	
—	B50-0791-00	Instruction manual	
—	B58-0003-00	Power voltage caution card	
—	B58-0101-00	Power voltage caution card	
E1	E08-0207-05	AC receptacle	
E2	E08-1203-05	12P receptacle	
—	E08-1207-05	12P receptacle	
—	E09-1201-05	12P plug socket	
—	E30-0034-05	Power cord	
F1	F04-6021-05	Fuse (6A)	
—	F05-8021-05	Fuse (8A)	
—	H01-0767-04	Carton case	
—	H03-0109-04	Carton case	
—	J02-0005-04	Sub legs x 2	
—	J02-0010-04	Legs x 4	
—	J13-0004-05	Fuse holder	
—	J19-0006-04	Switch stopper	
—	J21-0723-04	Electrolytic block stopper	
—	J21-0724-23	Speaker stopper	
T1	L03-0044-05	Power transformer	
—	N08-0070-04	Terminal	
VR1	R03-3030-05	Potentiometer 20k Ω (B)	
—	S59-2017-05	Selector switch	
SP1	T13-0005-15	Speaker	

■ PC BOARD OF X43-0005-00

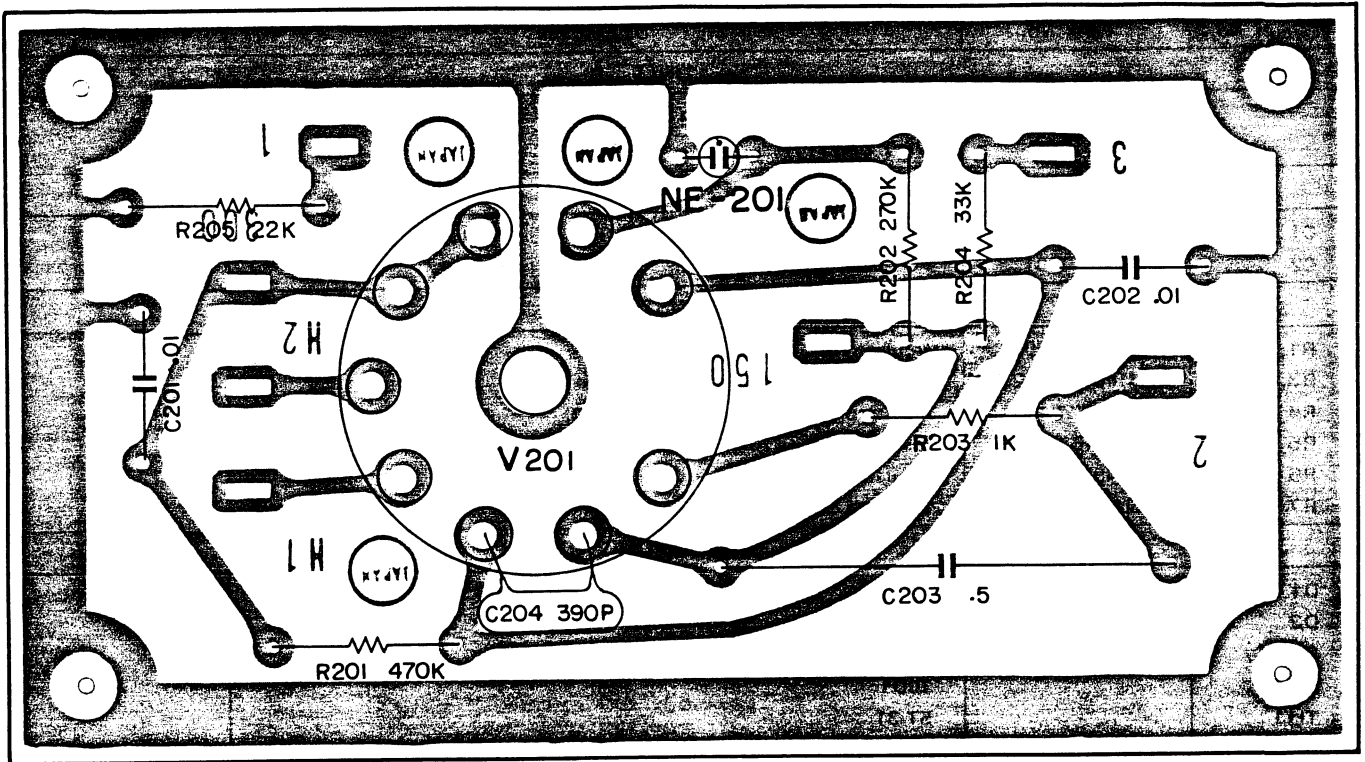


D101 ~ 104: S-1.5-08, D105 ~ 108: S-05-06, D109: S-05-04

■ PARTS LIST OF X43-0005-00

Circuit No.	Parts No.	Description	Remarks
CAPACITOR			
C101 ~ 108	CK94YZ2H103P	Ceramic	0.01 μ F +100% -0%
C109, 110	CE02D2C400	Electrolytic tubular	40 μ F 350WV
RESISTOR			
R101 ~ 108	RC05GF2H474K	Carbon composition	470k Ω \pm 10% 1/2W
R109	RC05GF2H222K	Carbon composition	2.2k Ω \pm 10% 1/2W
SEMICONDUCTOR			
D101 ~ 104		S-1.5-08	
D105 ~ 108		S-05-06	
D109		S-05-04	

■ PC BOARD OF X43-0004-01



NE-201: NE-2, V201: 6BM8

■ PARTS LIST OF X43-0004-01

Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C201, 202	CK94Y22H103P	Ceramic	0.01μF	+100%	−0%	
C203	CH05R2C504M	Metalized paper	0.5μF	±20%		
C204	CK94YX2H391K	Ceramic	390pF	±10%		
RESISTOR						
R201	RC05GF2H474K	Carbon composition	470kΩ	±10%	1/2W	
R202	RC05GF2H274K	Carbon composition	270kΩ	±10%	1/2W	
R203	RC05GF2H102K	Carbon composition	1kΩ	±10%	1/2W	
R204	RC05GF2H333K	Carbon composition	33kΩ	±10%	1/2W	
R205	RC05GF2H223K	Carbon composition	22kΩ	±10%	1/2W	
TUBE						
V201		6BM8				
MISCELLANEOUS						
Ne201		Neon glow lamp NE-2				
—	E10-1901-05	Tube socket (9P)				
—	J25-0364-04	PC board				

■ PARTS LIST VFO-5S (Y57-0008-05)

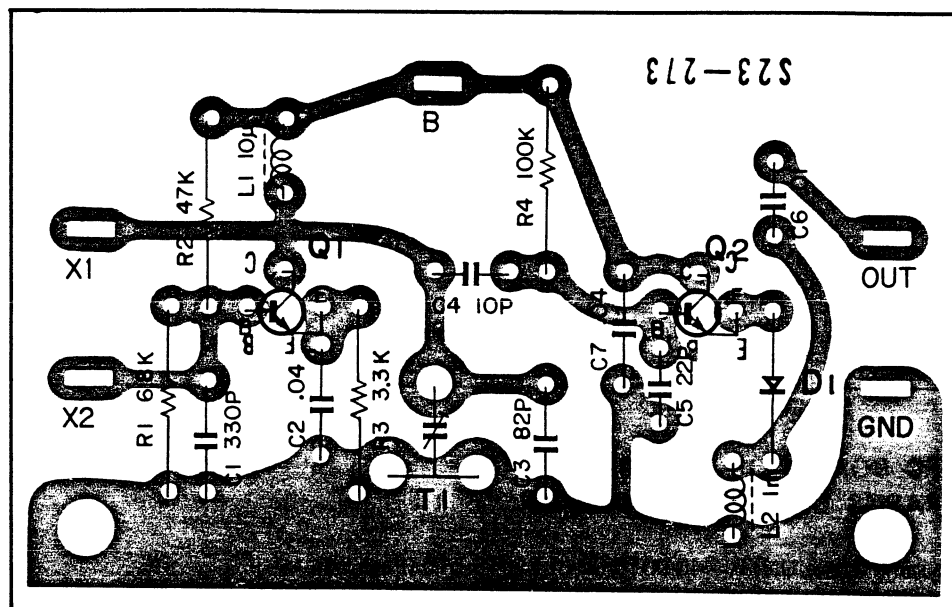
Circuit No.	Parts No.	Description	Remarks
UNIT			
—	X40-0013-00	CRYSTAL OSCILLATOR UNIT	
—	X40-0016-02	VFO UNIT	
CAPACITOR			
C1	CK94YZ2H103P	Ceramic 0.01μF +100% —0%	
C2	CE04W1E101	PC electrolytic 100μF 25WV	
RESISTOR			
R1,2	PD14BY2E102J	Insulated carbon film 1kΩ ±5% 1/4W	
R3	PD14BY2E332J	Insulated carbon film 3.3kΩ ±5% 1/4W	
R4	PD14BY2E102J	Insulated carbon film 1kΩ ±5% 1/4W	
R5	RN14AB3F153J	Insulated carbon film 15kΩ ±5% 1/4W	
R6	PD14BY2E154J	Insulated carbon film 150kΩ ±5% 1/4W	
R7	RN14AB3T562J	Insulated carbon film 5.6kΩ ±5% 1/4W	
SEMICONDUCTOR			
D1		RD-9AM	
D2		SM-150-01	
D3		RD-9AM	
D4		10D1	
TH1		5T-31	
MISCELLANEOUS			
—	A01-0132-03	Case	
—	A10-0229-12	Chassis	
—	A20-0468-03	Panel assembly	
—	B01-0034-04	Side escutcheon (A)	
—	B01-0035-04	Side escutcheon (B)	
—	B03-0030-04	Dial escutcheon	
—	B07-0068-03	VFO escutcheon	
—	B19-0092-04	Acrylboard (A)	
—	B20-0179-14	Dial board	
—	B30-0007-05	Pilot lamp	
—	B30-0044-05	Pilot lamp bracket	
—	B42-0009-04	Passed sticket	
—	B50-0751-00	Instruction manual	
E2	E01-0801-05	US socket	
E3	E01-0903-05	9 pin miniature socket	
—	E05-0901-05	9 pin plug	
E1	E15-0010-05	Pilot lamp socket	
—	E18-0203-05	Crystal oscillator socket	
—	E18-1201-05	Relay socket	
—	H01-0657-04	Carton case	
—	H03-0053-04	Carton case	
—	J01-0014-04	Legs (metal) x 2	
—	J02-0005-04	Sub legs x 2	
—	J02-0010-04	Legs x 2	
—	J12-0048-05	Relay stopper	
—	J21-0719-04	Dial stopper	

Circuit No.	Parts No.	Description	Remarks
—	K21-0209-13	Knob (MAIN)	
—	K21-0213-04	Knob (RIT)	
—	K21-0210-04	Knob (FUNCTION)	
—	K29-0046-04	Thumb collar	
—	S10-1079-05	Rotary switch	
—	S31-2023-05	See-saw switch	
RL1	S51-4016-05	Relay	
VR1	R03-2015-15	Potentiometer	
VR2	R12-3011-05	Trimmer potentiometer	

- PC BOARD OF X40-0016-02
- PARTS LIST OF X40-0016-02

The same as the UNIT. X40-0016-02 of the TS-515 (Page 54)

■ PC BOARD OF X40-0013-02

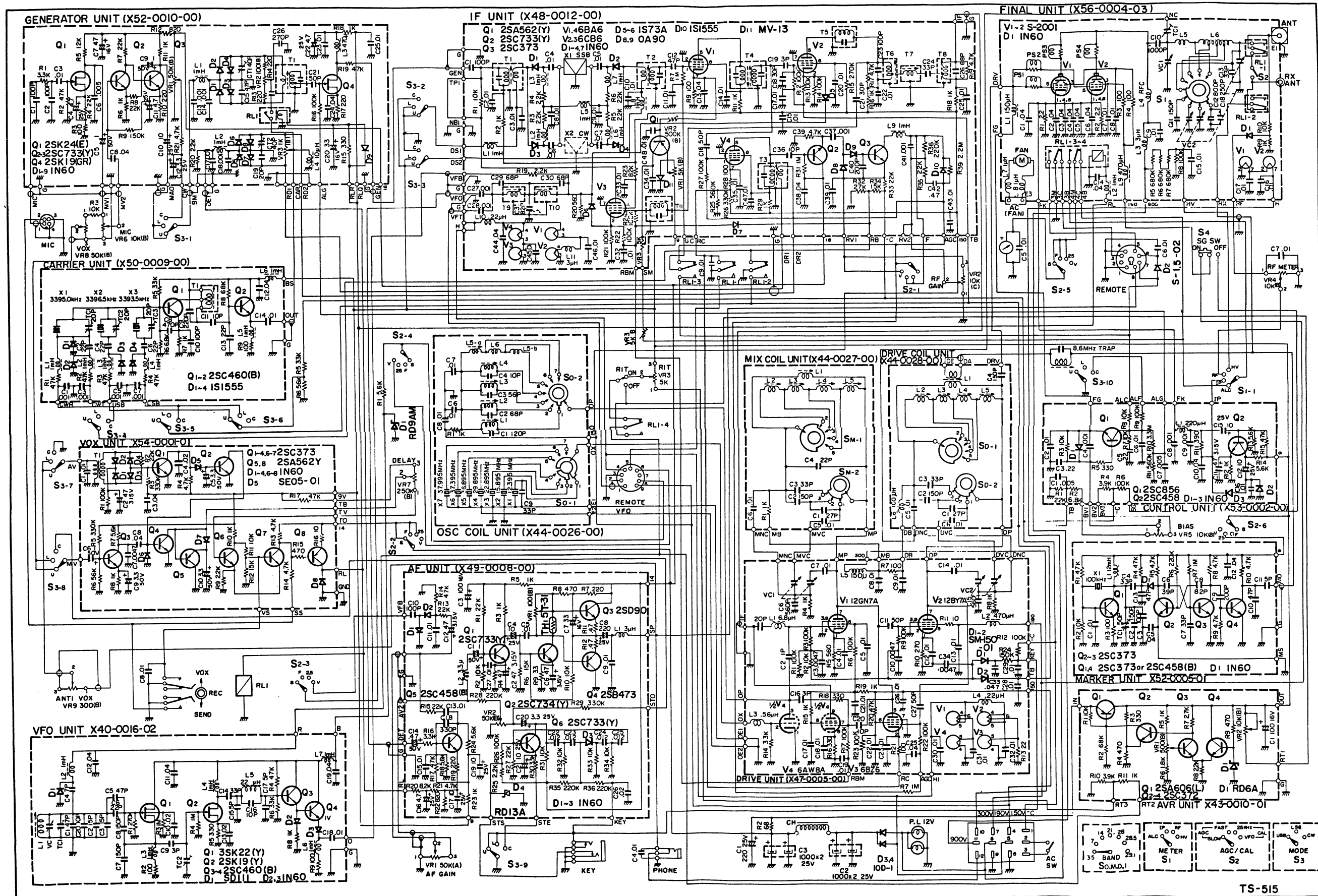


Q1, 2: 2SC460(B), D1: 1N60

■ PARTS LIST OF X40-0013-02

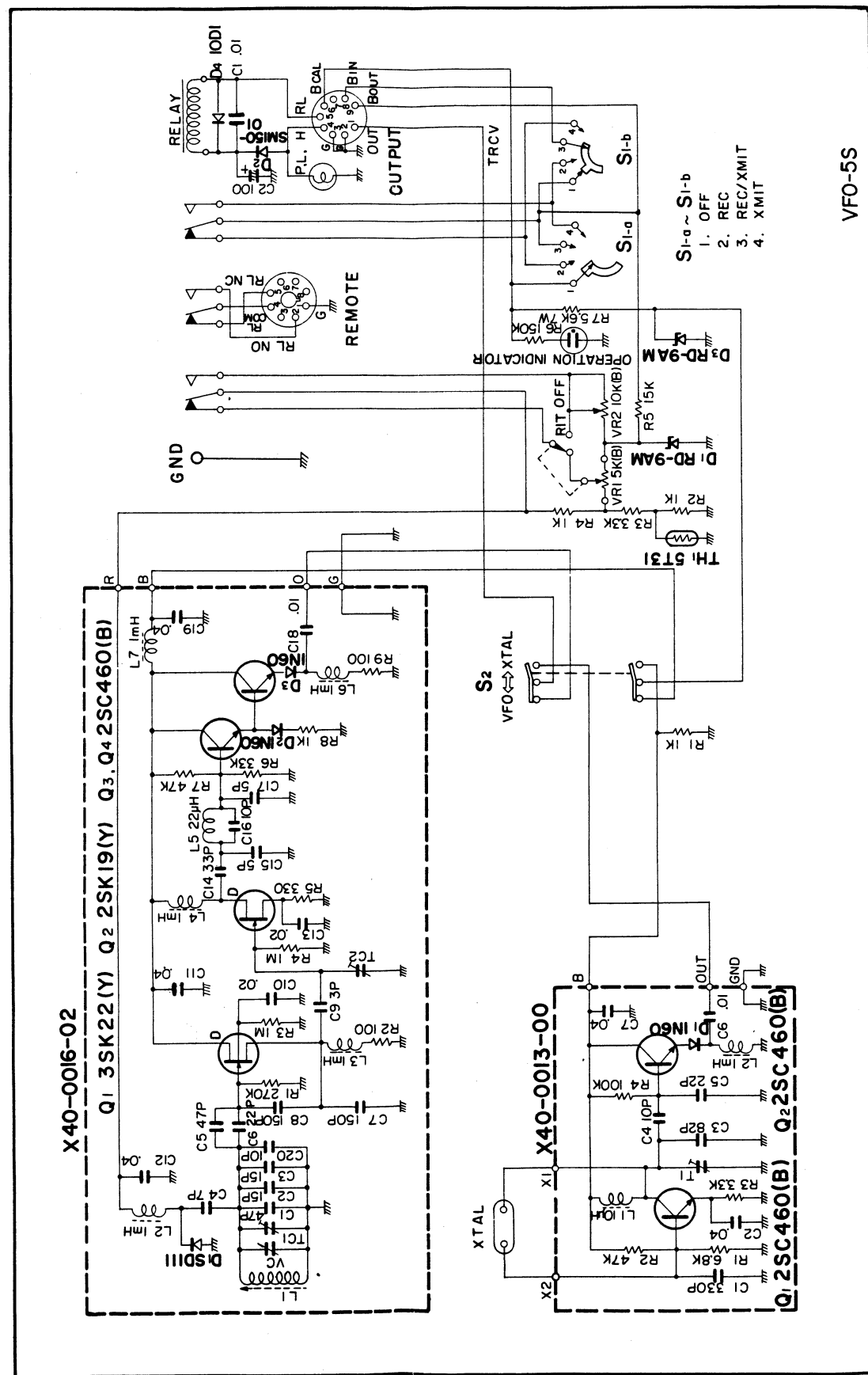
Circuit No.	Parts No.	Description				Remarks
CAPACITOR						
C1	CM93D2A331J	Mica	330pF	±5%		
C2	CK94YZ1H403P	Ceramic	0.04μF	+100% −0%		
C3	CM93D2H820J	Mica	82pF	±5%		
C4	CM93D2H100J	Mica	10pF	±5%		
C5	CM93D2H220J	Mica	22pF	±5%		
C6	CK94YZ1H103P	Ceramic	0.01μF	+100% −0%		
C7	CK94YZ1H403P	Ceramic	0.04μF	+100% −0%		
T1	C05-0015-05	Ceramic trimmer				
RESISTOR						
R1	PD14BY2E682J	Insulated carbon film	6.8kΩ	±5%	1/4W	
R2	PD14BY2E473J	Insulated carbon film	47kΩ	±5%	1/4W	
R3	PD14BY2E332J	Insulated carbon film	3.3kΩ	±5%	1/4W	
R4	PD14BY2E104J	Insulated carbon film	100kΩ	±5%	1/4W	
SEMICONDUCTOR						
Q1, 2		2SC460 (B)				
D1		1N60				
COIL						
—	L33-0089-05	Ferri-inductor				
—	L33-0104-05	Ferri-inductor				
—	J25-0360-04	PC board				

SCHEMATIC DIAGRAM OF TS-515

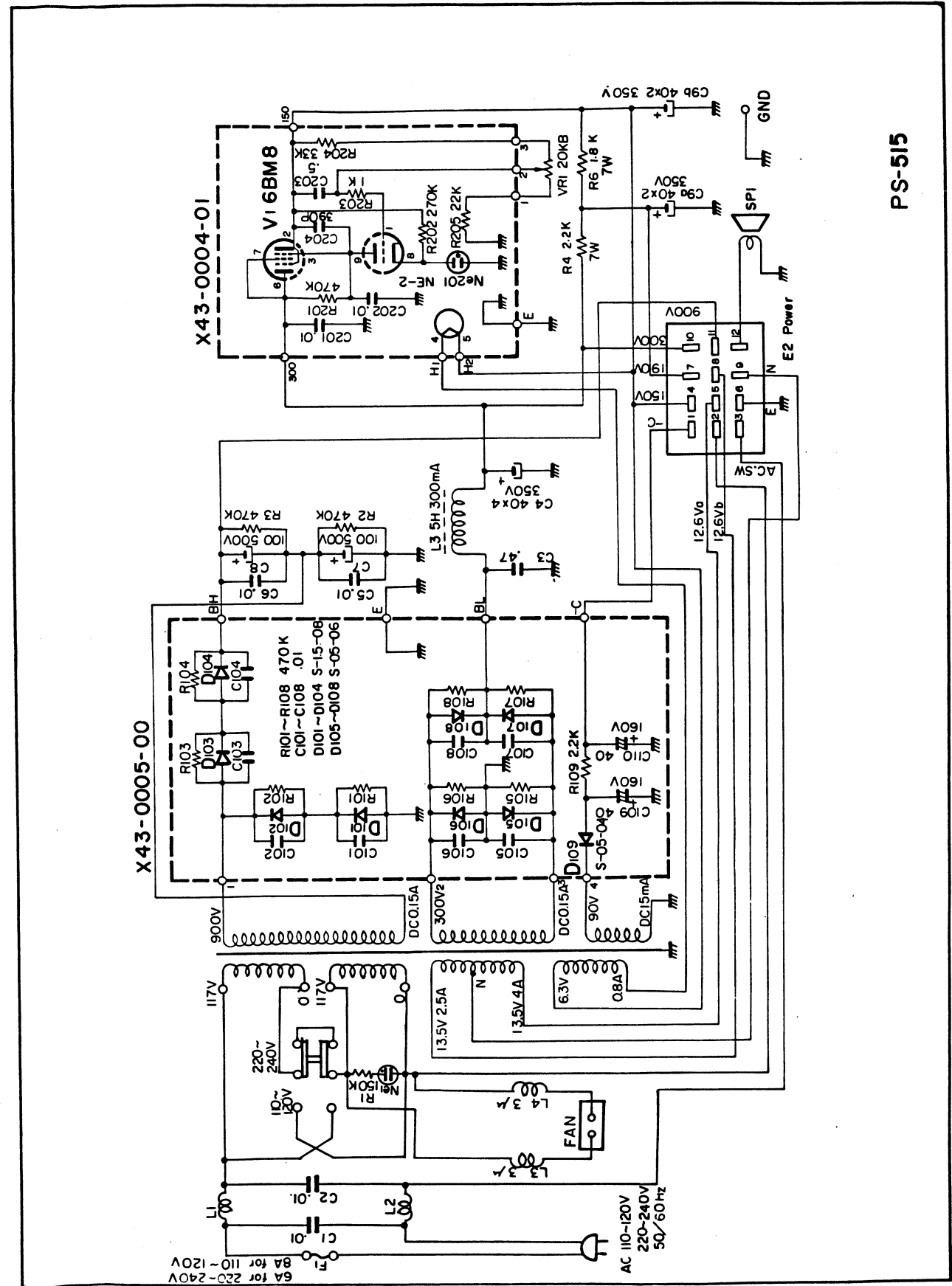


TS-515

SCHEMATIC DIAGRAM OF VFO-5S



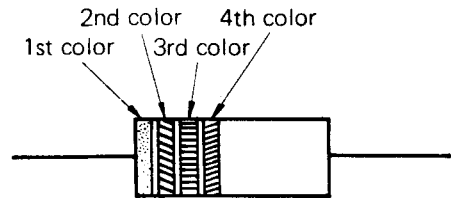
SCHEMATIC DIAGRAM OF PS-515



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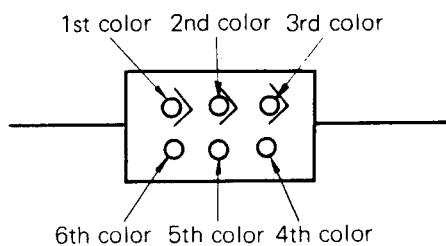
RESISTOR

COLOR (meaning)	1st (value)	2nd (value)	3rd (multiplier)	4th (tolerance)
Black	0	0	10^0	—
Brown	1	1	10^1	$\pm 1\%$
Red	2	2	10^2	$\pm 2\%$
Orange	3	3	10^3	—
Yellow	4	4	10^4	—
Green	5	5	10^5	—
Blue	6	6	10^6	—
Purple	7	7	10^7	—
Grey	8	8	10^8	—
White	9	9	10^9	—
Gold	—	—	10^{-1}	$\pm 5\%$
Silver	—	—	10^{-2}	$\pm 10\%$
Non-color	—	—	—	$\pm 20\%$



CAPACITOR (MICA)

COLOR (meaning)	1st (grade)	2nd (value)	3rd (value)	4th (multiplier)	5th (tolerance)	6th (characteristic)
Black	X	0	0	10^0	$\pm 20\%$	—
Brown	—	1	1	10^1	$\pm 1\%$	B
Red	Z	2	2	10^2	$\pm 2\%$	C
Orange	—	3	3	10^3	—	D
Yellow	—	4	4	10^4	—	E
Green	—	5	5	—	* $\pm 5\%$	—
Blue	—	6	6	—	—	—
Purple	—	7	7	—	—	—
Grey	Y	8	8	—	—	—
White	—	9	9	0.1	$\pm 10\%$	—



Unit = pF

* Capacitance being less than 10pF is $\pm 0.5\text{pF}$ on tolerance.